# UNIVERSITY OF NATAL

PIETERMARITZBURG
SOUTH AFRICA

# WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

## REPORT FOR 1959–1960

(THIRTEENTH YEAR)

OCTOBER, 1960

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# COMMITTEE OF CONTROL OF THE INSTITUTE

**Appointed by the South African Wattle Growers' Union (3):**

S. Clegg, Esq. (*Resigned November*, 1959).
Major C. J. J. Crowe (*Vice-Chairman*).
S. J. F. Nuss, Esq.
T. F. Mackenzie, Esq. (*Appointed November*, 1959).

**Appointed by the University of Natal (2):**

Professor A. J. W. Bayer, D.Sc. (*Chairman*).
Principal E. G. Malherbe, M.A., Ph.D., LL.D.

*Alternate:* H. H. Cornell, Esq., B.A. (*Resigned November*, 1959).
Professor E. R. Orchard, M.B.E., B.Sc., Ph.D., F.R.I.C. (*Appointed November*, 1959).

**Appointed by the Union Government Department of Forestry (2):**

M. van N. Möhr, Esq., B.Sc.
J. H. van Wyk, Esq., M.Sc., M.F. (*Appointed November*, 1959).

**The Director:**

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

**Honorary Secretary:**

P. G. Leeb-du Toit, Esq., B.Com. (*Registrar, University of Natal*).

# STAFF

(SEPTEMBER, 1960)

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**DIRECTOR:**

H. Shaw, M.Sc.Tech., Ph.D. (Manc.), F.R.I.C.

**Silviculture:**

S. P. Sherry, M.A. (Oxon.), B.Sc. (South Africa).
K. Roberts, B.Sc. (Wales). (*Resigned August,* 1960).
R. J. F. J. Atkins, B.Sc.For. (Stell.).

*Technical Assistants:*

M. J. Lourens.
A. M. MacKenzie.
I. S. Alexander.

**Genetics and Plant Breeding:**

A. A. Moffett, B.Sc. (Birm.), Ph.D. (Lond.).
Miss K. M. Nixon, M.Sc. (Natal).

*Technical Assistant:*

B. L. Arbuthnot, B.Sc. (Natal). (*Resigned February,* 1960).

**Chemistry:**

W. S. Martin, Ph.D., D.Sc. (Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, M.Sc. (Natal).

*Technical Officer:*

R. A. Jones.

**Entomology:**

L. L. J. Ossowski, M.F., For.Ing., D.Sc. (Poznan). (*Died* 21*st August,* 1960).

*Technical Officer:*

G. B. Wortmann, B.Sc. (Natal).

*Technical Assistant:*

R. E. Thurston. (*Appointed March,* 1960).

**Biometry:**

**Administration:**

Miss E. K. Smith.
Mrs. M. J. M. L. Gersbank. (*Resigned December,* 1959).

**Non-Europeans:**

Eight.

**Field Experiment Station Overseer (S.A.W.G.U.):**

M. A. Stewart.

# FOREWORD

In days of far-reaching change and widespread uncertainty, the Wattle Research Institute has by no means been left untouched. The year under review has, indeed, seen far more changes than any comparable period in the Institute's history.

The year closed on a note of sadness and grievous loss with the news of the death in London of Dr. Ossowski, the Institute's Chief Entomologist, thus bringing to a halt, at least temporarily, one of the most promising lines of work in the Institute. A tribute to Dr. Ossowski and his work appears elsewhere in this Report. A resignation from the research staff in addition brings the number down to the lowest level for some years, an altogether deplorable situation which is seriously hampering the work of the Institute at a time when a host of problems is demanding attention.

Changes have occurred, too, in the governing body of the Institute with the retirement from the Committee of Control of Mr. S. Clegg and Mr. H. H. Cornell, two gentlemen who have rendered invaluable service in past years. On the other hand, to their successors has been added another newcomer in the additional nominee of the Secretary for Forestry arising from the increased grant from the Department.

The Institute's main subject material has not escaped the prevailing changes, for the black wattle, long known as *Acacia mollissima* or, earlier, as *A. decurrens* var. *mollissima*, has recently been re-named as *A. mearnsii*. This change is notable mainly for its nuisance value, but as its authority is incontestable, it must be followed, and the new name is used throughout this Report.

Finally, the physical environment of the Institute is undergoing a radical change. Whereas only a few years ago the building stood in splendid isolation in undeveloped veld, it is likely soon to be in the midst of a built-up area, closely adjacent to the busy national road and a new housing estate.

Despite these interruptions and distractions, however, the essential work of the Institute has progressed steadily and with due attention to the problems arising from the changing circumstances of the wattle industry. The following pages present in review the activities of the Institute staff during the year 1959–60.

H. SHAW, *Director.*

October, 1960.

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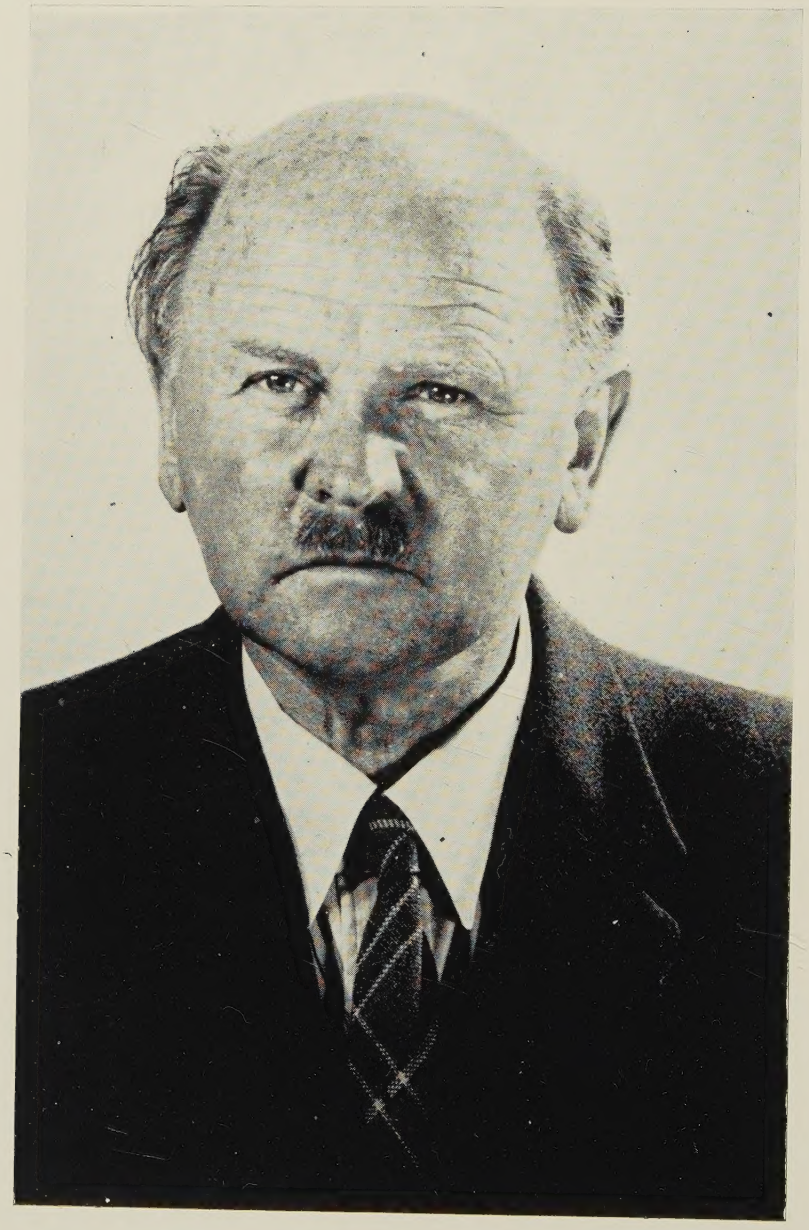

# DR. L. L. J. OSSOWSKI

**1905 - 1960**

Leon Lucjan Jan Ossowski was born on 16th May, 1905, in Henriettenhof, which was then in East Prussia. He was trained in Forestry and Forest Entomology at Poznan in Poland, where he took his D.Sc. in 1935, and at Munich in Germany. He entered the Polish State Forestry Service in 1928 as Junior Forester and served successively as Assistant Head Forester, as Deputy Chief, Administrative and Technical Division, as Officer in Charge of Forest Protection, and eventually as Chief Forester. It was in the latter capacity that he was on several occasions personal host to Hermann Goering on the latter's hunting expeditions, an experience that he spoke of only on specially expansive occasions.

On the outbreak of war in 1939, he joined the Polish armed forces as a cavalry officer and served through the short Eastern campaign until the collapse of the Polish army, when he was taken prisoner. He made his escape, however, and became an "underground" traveller through occupied Central Europe until he eventually rejoined the Polish forces on the Western Front, only to be severely wounded in the Maginot Line.

He was evacuated to Scotland and on his recovery was seconded to the Forestry Commission and Ministry of Supply as an Assistant Acquisition Officer. He was engaged in this work until, late in 1943, he joined the ill-fated Polish Government in Exile as Chief of the Polish Forestry Service. He held this post until the end of hostilities in Europe in 1945 and during this period visited the U.S.A. and Canada to study the organization of research. In September, 1945, he returned to the Forestry Commission for a year or so and then joined the Scottish Co-operative Forestry Society as a consultant. In all these varied activities, his work was marked, according to colleagues of that period, by great energy and enthusiasm, qualities which everyone who knew him quickly came to recognize.

Late in 1947, Ossowski sought fresh pastures and came to South Africa to join the Union Department of Forestry as a Forest Research Officer, but in 1949, he made his final move on being appointed head of the newly established Entomology Section of the Wattle Research Institute in Pietermaritzburg. Here, in a somewhat narrower field, he applied himself with characteristic verve to an intensive study of the wattle fauna. Inevitably his main interest was centred in the wattle bagworm, but he started records of the incidence of other wattle insects which for continuity and thoroughness are models of their kind.

For several years he worked in close collaboration with public service officers of the Division of Entomology, but as circumstances compelled the Division to withdraw progressively from active participation in research on wattle pests, he eventually found himself alone in this field. Among wattle growers he will be remembered for his organization of the annual bagworm surveys and commercial spraying programmes. His energy in this work was astonishing, and when aerial surveys became necessary to cover the large areas involved, he took to this medium with equal zest. Yet throughout this period, he was battling with recurrent illness which at times seriously overtaxed his physical resources.

He brought to this work a highly critical mind and was quick to see the deficiencies and the positive dangers of mass attempts at chemical control of the bagworm. This caused his interest to turn to the possibilities of biological control, particularly by means of the polyhedral wilt disease caused by a virus occurring naturally in this insect. Stimulated and encouraged by a visit to K. M. Smith's laboratory in Cambridge, he launched out in 1955 into a field of work which, in its technical niceties, was entirely new to him. He was at all times, however, a voracious reader of both technical and lay publications, and he very soon familiarized himself with the literature of his new interest. Thus he forced his way to the forefront of field work on insect viruses and his investigations were among the most advanced of their kind. It is for this work of his latest years that the scientific world will remember him and mourn the loss of a pioneer.

This work brought him international recognition and a world-wide circle of scientific correspondents. It brought him, too, an invitation to organize and conduct the sub-section on insect viruses at the Eleventh International Congress of Entomology in Vienna. He was on his way there when he was overtaken by serious illness at Passau in Germany and he died in London on Sunday, 21st August, 1960.

Ossowski's passion for orderliness amounted almost to an obsession. Unpunctuality, inaccuracy, untidiness, and slackness of every kind were anathema to him. Every instruction was committed to paper—in duplicate; every discussion or remark of significance was placed on written record. His field experiments were organized along the lines of military operations, and woe betide any defaulter. In the eyes of many, he was thus endowed with a somewhat awe-inspiring mien, an impression which was not diminished by his imposing physical presence. All this, however, served only to mask a pungent wit, a rich sense of humour, and good fellowship which soon became apparent on more intimate acquaintance. His passion for tidiness extended to his published work and it is quite characteristic that at the time of his death, the last experiment of the previous season had been written up. Before joining the Institute he had published over fifty articles, mostly in Polish and German forestry periodicals, and his contribution to the scientific literature during his eleven years at the Institute comprised a further thirty or so papers.

His European background and subsequent travels, together with a natural flair for languages, made him an accomplished linguist. Polish speaking by origin and German speaking by education and environment, he became equally fluent in English and very nearly so in French and Afrikaans. He had more than a smattering, too, of Russian, Italian, and several Central European languages.

Dr. Ossowski was not a man who would be overlooked or ignored in any circle. While he will be remembered for his strong and determined personality and his complete devotion to the things to which he addressed himself, he leaves memories, too, of a lively and informed conversationist who deeply enjoyed such refinements of life as he found in good music, good books, and good food.

The magnitude of the Institute's loss is almost beyond calculation, and it is no less a loss to the wattle industry as a whole. More than this, it is a loss to the wider fields of forest entomology and insect pathology; men of such zeal, enthusiasm, and ability are too few to be readily spared.

# ADMINISTRATIVE REPORT

## BUILDINGS AND PLANTATIONS

**Main Building.**

Two opposing forces have been at work around the Institute during the past year. On the one hand, the efforts to give the building a more ordered and attractive setting have been continued, and through the good offices of the Corporation Parks Department and its Director, the terrace rockery has been furnished with a variety of plants and some 30 trees have been established in groups along the National Road frontage. On the other hand, the Institute has been virtually surrounded by building and constructional works outside its control which have largely, but fortunately only temporarily, defeated these efforts, and it stands at the moment in the midst of a chaos of builders' and road-makers' rubble.

The new National Road, started just over a year ago, has been completed along the northern boundary of the campus, whilst immediately adjacent to the Institute on the eastern side, the lay-out of a housing estate has taken shape. Thus, for the first time, the precise boundaries of the campus and the ground available to the Institute have become clearly evident and revealed how the main building has, quite literally, been cornered. This is an important consideration in view of plans and projects which may, in due course, call for substantial expansion of the Institute.

In addition to routine maintenance and fairly extensive roof repairs, the buildings have been re-decorated externally during the past winter.

**Field Experiment Station.**

Unfavourable climatic conditions towards the end of the season caused harvesting operations to be curtailed, and only 32·7 acres were stripped. Of the 32·5 acres re-established, 23·9 acres were placed immediately under experiments, while the remaining 8·6 acres are available for bagworm infestation studies as required.

Several new sections of road, amounting to 1,100 yards in all, were made during the year, bringing the total on the farm to over 20 miles. Because of other heavy demands upon the funds of the South African Wattle Growers' Union, no addition has been made to the demonstration group of houses for farm labour and no work was done on the projected dam.

Following the geological survey of the farm in the previous year, two boreholes have been drilled. These are intended primarily to form part of the research investigation on the response of underground water to changing phases in the plantation cycle, and for this purpose, they have been equipped with continuous recording instruments by the Geological Survey. The boreholes will, however, be available as water supply sources in case of need.

The failure to complete the scheduled stripping programme in 1959–60 just turned the balance of income and expenditure, causing the farm to show a small working loss. It should be said again, however, that this, rather than the production of substantial profits, is to be regarded as the normal position for an experimental farm of this nature.

## ADMINISTRATION AND FINANCE

The past year has seen more extensive changes than ever before in the personnel of the Committee of Control, three new members having been appointed and two others having resumed their connection after a temporary absence.

The first meeting in 1959–60 was the occasion of the departure of the last remaining original member of the Committee, when Mr. S. Clegg intimated that, because of his impending retirement from business at the end of the year, he would no longer be available to serve. Mr. Clegg joined the Committee at its inception in 1946 and had maintained unbroken membership for over thirteen years, for more than half of which he had been Chairman. Throughout this period, he took a very active part in the management of the Institute's affairs, especially in matters relating to the South African Wattle Growers' Union. Among these, finance inevitably figured very largely, as much the greater part of the Institute's funds are derived from the Union. Here Mr. Clegg's business experience and acumen were invaluable, and it was always an encouragement to know that any decision or recommendation made by the Committee would be powerfully supported in the counsels of the Wattle Growers' Union. His strong personality will be missed from the Committee and his place will not easily be filled nor his personal contribution readily replaced.

A few weeks later, Mr. H. H. Cornell ended his connection with the University Council on retiring from his post as Director of the Natal Region of the Department of Agriculture. He thus ended his period of office on the Committee of Control as alternate to the Principal. In the dual role of Treasurer of the University and a senior member of the public service, Mr. Cornell had been able to give much valuable guidance and advice during the two and a half years he had been a member of the Committee. He had also served as the Institute's nominee to the S.A.W.G.U. Field Experiment Station Committee.

The best wishes of the Institute and the remaining members of the Committee are extended to Mr. Clegg and Mr. Cornell in their retirement. They have been replaced respectively by Mr. T. F. Mackenzie, a Vice-Chairman of the Wattle Growers' Union, and Professor E. R. Orchard, Head of the Department of Soil Science in the University of Natal and a member of the University Council.

Early in the year, the conditions attaching to the increased government grant to the Institute were formally accepted and this brought into operation the clause giving to the Department of Forestry an additional representative on the Committee of Control. The Secretary for Forestry's nominee for this office is Mr. J. H. van Wyk, Chief Research Officer in the Department. All three newcomers are cordially welcomed into association with the Institute.

On his return from long leave overseas, Professor A. J. W. Bayer resumed his position as representative of the University Council on the Committee. The University Registrar, Mr. P. G. Leeb-du Toit, found it possible to take up again the office of Honorary Secretary after a break of several months caused by pressure of other University duties.

Three ordinary meetings of the Committee were held during the year. At the outset, Professor Bayer was appointed to succeed Mr. Clegg as Chairman and Major C. J. J. Crowe was re-elected Vice-Chairman. Mr. M. van N. Möhr was nominated as assessor member of the S.A.W.G.U. Field Experiment Station Committee.

Welcome as it is, the increased Government grant to the Institute is still regarded by the Wattle Growers as inadequate, and further representations have been made by the Union. The new proposals are based on a suggestion made by the present Secretary for Forestry in 1957 and envisage the broadening of the Institute's terms of reference to include all forestry research in the province of Natal.

The research staff salary scales were again revised during the year to keep them in line with University staff scales, but because of the difficult financial position of the

Wattle Growers' Union, a temporary ceiling below the maximum was placed upon the salaries of all the senior members of the staff. Later in the year, and with effect from 1st September, 1960, adjustments were made in the salaries of members of the technical staff.

**Expenditure and Income.**

The Institute again suffered the enforced and unwelcome economy arising from staff vacancies unfilled and, in consequence, total expenditure for the year was over £3,500 below the estimate, even after meeting the unbudgeted adjustment of salary scales mentioned above. The overall increase in expenditure of nearly £2,900 as compared with the previous year was accounted for by salary increases, the abnormally high expenditure on travelling occasioned by an overseas visit, and external redecoration of the buildings. Other expenditure was around normal apart from the unusual item of about £200, the cost of the two bore-holes at Bloemendal.

On the income side, the Institute had the benefit of the first full year of the increased Government grant. Fees for analytical services were slightly more than in 1959–60.

The summarized statement of Expenditure and Income for the period 1st September, 1959, to 31st August, 1960, appears below. Detailed Accounts and Balance Sheet are published separately.

## RESEARCH INSTITUTE ACCOUNT

### 1st September, 1959, to 31st August, 1960

| *Expenditure* | £ | s. | d. | *Income* | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| Research and Administrative Staff Salaries, etc. | 25,213 | 19 | 9 | S.A.W.G.U. Grant | 21,809 | 4 | 5 |
| Travelling and Subsistence | 2,160 | 8 | 0 | Department of Forestry Grant | 10,000 | 0 | 0 |
| Laboratory and Office Equipment and Maintenance | 1,265 | 8 | 3 | Analytical Services | 155 | 8 | 0 |
| New Vehicle (less trade-in) | 682 | 0 | 0 | | | | |
| Library | 295 | 15 | 4 | | | | |
| Printing and Stationery | 299 | 5 | 3 | | | | |
| General Administration | 752 | 10 | 6 | | | | |
| Building Maintenance | 582 | 12 | 10 | | | | |
| Building Additions | 212 | 12 | 6 | | | | |
| Special Provident Fund Reserve | 500 | 0 | 0 | | | | |
| | £31,964 | 12 | 5 | | £31,964 | 12 | 5 |

## STAFF

For the second successive year, the Institute has to record the grievous and unexpected loss by death of an active member of its staff. At the end of June, Dr. L. L. J. Ossowski, Head of the Entomology Section, went overseas to take part in entomological meetings in London and Vienna, but while travelling through Germany, he was taken ill and hurried back to London, where an operation was performed. This appeared to have been successful, but Dr. Ossowski suffered a relapse and died on Sunday, 21st August, 1960. The Entomology Section is thus left at present entirely without research officers.

During the year, Mr. K. Roberts was overseas on long leave on completion of five years service in the Institute. At the end of August, however, he resigned his post as Assistant Silviculturist to join the Colonial Forestry Service in Northern Rhodesia. Mr. B. L. Arbuthnot, a Technical Assistant in the Genetics Section, returned to full-time work in the Institute after completing the B.Sc. degree in the University, but resigned shortly afterwards to take up an industrial appointment. In December, Mrs. M. J. M. L. Gersbank resigned her post as office assistant.

On the other hand, Mr. R. E. Thurston joined the staff in March as Technical Assistant in the Entomology Section. Another Technical Assistant and the long-sought Plant Physiologist have also accepted appointments, but neither can assume duties until early in 1961. In view of the type of work upon which they are engaged, Mr. R. A. Jones and Mr. G. B. Wortmann were transferred at the beginning of the year to the newly adopted grade of Assistant Technical Officer.

There are at present vacant in the Institute the posts of Senior and Assistant Entomologists, Biometrician, and Assistant Silviculturist. Advertisement of two of these towards the end of 1959 brought no response.

Miss E. K. Smith suffered a long period of illness and returned to duty only just before the end of the year. During her absence, Mrs. P. M. Allison again proved a most efficient substitute. A Natal University student was employed in the Entomology Section for a short time in September.

There was again no application for the Wattle Research Institute Scholarship and consideration is to be given to converting this to an undergraduate bursary.

## ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

### Advisory.

The rising trend in the number of advisory letters written continued, but the number of those relating to insect pests rose even more sharply and amounted to no less than 326 out of a total of 399. This reflects the rising incidence of wattle bagworm, and the intense activity in the survey and the organization of the commercial spraying campaign. While the greatest number of letters (254) again related to enquiries from Natal, the increase was most marked in those (113) addressed to the Transvaal. Enquiries were received from 20 countries outside the Union, among which Canada and Pakistan appeared for the first time.

Visits to growers' plantations were rather fewer than in the previous year, but at 82 remained at a level higher than average. These visits again covered the whole range of the wattle growing areas, but over half of them were in the northern districts.

At about 100, the number of visitors to the Institute was somewhat above average. These included Mr. D. R. de Wet, Secretary for Forestry in the Union Government, a party of staff and students numbering 15 from the Faculty of Forestry, University of Stellenbosch and, at different times, Professors C. R. Wicht and P. P. du T. Deetlefs of the same Department. From outside the Union came Professor J. Horring of The Hague, Holland, Dr. W. Lloyd Jenkins, newly appointed to the University College of Southern Rhodesia, and Mrs. Jenkins, Dr. Paul Surany of the South Pacific Commission, New Caledonia, Dr. F. J. Simmonds, Director of the Commonwealth Institute of Biological Control, Canada, Mr. T. Greaves, of the Division of Entomology, C.S.I.R.O., Australia, and Mrs. Greaves, Mr. V. Grenning, Director of Forestry, Queensland, Australia, and Mrs. Grenning, and Professor Oscar Rey, of the University of Ljubljana, Yugoslavia.

Most of these visitors were conducted over the Experiment Station Bloemendal, which was visited during the year by some 95 persons either as individuals or in small parties. Practical demonstrations on wattle silviculture and management were given to students from the Cedara College of Agriculture and from the Faculty of Agriculture in the University of Natal. The Annual Farmers' Field Day was held on 24th March and again proved highly successful, upwards of 80 visitors enjoying a fine day for the visit. Emphasis this year was upon aspects of the silviculture and plant breeding programs.

Several public authorities, both in South Africa and overseas, have sought advice and information from the Institute, among these being the Union Government Departments of Agriculture, Commerce and Industries, Forestry, and Water Affairs, the Natal Provincial Roads Department, the Swaziland Government Land Utilization Department, the Tobacco Research Board of Southern Rhodesia, and the Ministry of Agriculture of the Argentine. The usual variety of enquiries on technical and industrial matters has been received.

The number of commercial wattle bark samples submitted by the Government Bark Inspector for analysis was maintained at the high level of the previous year. This included a number of suspect barks where assistance in identification was sought.

The annual survey and analysis of bagworm population was again carried out by the Entomology Section on behalf of the Wattle Growers' Union. Recommendations for commercial spraying were made and the treatment of 4,700 acres was supervised and the results observed. A forecast of the probable bagworm infestation was published in the *Farmer's Weekly* of 11th May, 1960.

Mr. Sherry contributed articles on the prevention of veld and forest fires to the *Natal Witness Royal Agricultural Show Supplement*, 22nd June, 1960, and to *NAUNLU* of 15th April, 1960.

Six scientific and technical papers were published during the year, while four others are in course of printing; details of the former are given on page 48 of this Report.

Institute staff assisted in preparing the Wattle Industry exhibit at the Royal Agricultural Society's 1960 show in Pietermaritzburg and advised the Forestry Department on wattle aspects of the Forestry exhibit in the Science Hall at the Industrial Show Grounds, Pretoria.

The Library has supplied several items under the inter-library loans scheme, while members of other Departments in the University have made considerable use of its resources in the course of research investigations. The University Departments of Commerce and of Economics were assisted by members of the staff in the preparation of special reports.

**Committees, etc.**

The prevailing circumstances in the wattle industry during the past year, especially in relation to legislation and other developments, have considerably increased the calls upon the time of several members of the staff for committee work.

The Director attended the Research Advisory Council and Wattle Technical Committee Meetings of the Leather Industries Research Institute at Grahamstown in June and, along with Dr. Martin and Mr. Gordon-Gray, another meeting of the Technical Committee in November. He also attended the Annual Meeting and official opening of the new buildings of the Paint Industries Research Institute in Durban in May.

The Director attended all the many meetings of the General Committee and of several sub-committees of the Wattle Growers' Union. He was also invited to sit

with the South African Wattle Extract Manufacturers Permanent Technical Committee when it met to formulate proposals in connection with the scheme for devoting some of the money in the Wattle Propaganda Fund to the expansion of research on the utilization of wattle products. He later joined the standing South African Wattle Research Advisory Committee set up along with a London committee to advise the African Territories Wattle Industry Publicity Fund Ltd. on wattle research. He continued in office as Chairman of the Wattle Timber Research Fellowship Steering Committee.

The Director and Mr. Sherry continued to serve on the Field Experiment Station Committee and the Royal Show Committee of the Wattle Growers' Union. Mr. Sherry was co-opted to the Wattle Industry Joint Quota Committee and served also on the Bark Grading and Price Formula Sub-committees. By arrangement, he served on the Executive Committee and Plantation Valuation Sub-committee of the South African Timber Growers' Association and on the Fire Protection Sub-committee of the Natal Agricultural Union.

With Dr. Ossowski, the Director continued on the Wattle Growers' Union Pest Control Committee and attended the first meeting of the Department of Agriculture's newly formed Co-ordinating Committee for Entomological Research in the Wattle Industry.

In May, Dr. Shaw was elected President of the Agricultural Scientific Society of Natal.

**Conferences, Lectures, Meetings, etc.**

At the end of June, Dr. Ossowski left to attend the Seventh Commonwealth Entomological Conference in London and the Eleventh International Congress of Entomology in Vienna. He was present at the London meetings and read a paper on "A Virus Disease in the Biological Control of the Wattle Bagworm". During this Conference, he was invited to sit as an observer with the sub-committee on Biological Control. As reported elsewhere, however, he was prevented by illness and his subsequent death from proceeding to Vienna. His paper entitled "A Polyhedrosis Virus in Wattle Bagworm Control" was read in his absence, and high tribute was paid to his organization of the Section on Insect Viruses, over which he was to have presided. *En route* to London, Dr. Ossowski had had discussions with F.A.O. authorities in Rome on forest insect control. Earlier in the year he had addressed a meeting of the Northern Districts and Eastern Transvaal Wattle Syndicate on aerial spraying against bagworm.

The Institute collaborated with the South African Timber Growers' Association in arranging a number of Field Days and the Director, Mr. Sherry, and Mr. Wortmann took part in one or more of these and other similar meetings at Eston, Kaapsche Hoop, Kambula, Karkloof, Lothair, and Mid Illovo. Mr. Atkins gave similar talks at the Bremersdorp and Goedgegun Agricultural Shows in Swaziland.

Mr. Sherry gave an address on fire prevention and control to the Annual Congress of the South African Timber Growers' Association and, *in absentia*, presented a paper entitled "Experimental Measurements of Runoff and Soil Erosion in Wattle Plantations in Natal" to the Third Inter-African Soils Conference in Dalaba, Guinea.

## LIBRARY

After the spurt in accessions during the previous year, the number of new books received in the Library during 1959–60 was only 12. Owing to a delay in binding, the number of newly bound periodicals was, at 28, also well below average. The totals in these two groups are now 383 and 437 respectively. The accession of bulletins, reprints, etc. was fairly well maintained and the 259 received brought the total to 3,191.

Thanks are due to the Paint Industries Research Institute for a copy of Mr. S. E. Drewes's thesis "Fundamental and Applied Studies on Black Wattle Tannin".


## ACKNOWLEDGEMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned.

To the Director and Staff of the City Parks Department for the provision and planting of trees, shrubs, and herbaceous plants around the Institute.

To Dr. A. Beryl Beakbane and Mr. R. J. Garner, of East Malling Research Station, for co-operation in investigating the vegetative propagation of black wattle.

To the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) for assistance in identifying entomological material.

To Dr. P. H. B. Talbot of the Division of Botany, Department of Agricultural Technical Services, for identifying fungus material.

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# REVIEW OF WORK IN PROGRESS

## (a) SILVICULTURE

### 1. Thinning Experiments.

Harvesting of further portions of the experiments designed to determine optimum final density in relation to rotation length took place during the year.

Concurrently with this harvesting, the trees on the remaining portions of the respective experiments were measured to determine suppression relationships for the age and site concerned.

(*a*) The third portion of experiment S.1 at Broadmoor (Wartburg district) was harvested in March, 1960, at eleven years of age.

Results from the harvested plots were as follows:

| Nominal density per acre at harvesting | Mean d.b.h. (inches) | Mean d.b.h. 250 dominants per acre (inches) | Mean percentage tannin content (moisture-free basis) | Mean undried bark yield (long tons per acre) | Mean tannin yield (long tons per acre) |
|---|---|---|---|---|---|
| 700 | 5·4 | 6·7 | 36·18 | 13·33 | 2·30 |
| 650 | 5·5 | 6·5 | 36·53 | 13·66 | 2·33 |
| 600 | 5·7 | 6·6 | 37·93 | 13·40 | 2·39 |
| 550 | 5·9 | 6·9 | 38·45 | 12·59 | 2·34 |
| 500 | 6·1 | 6·7 | 37·95 | 11·94 | 2·17 |
| 450 | 6·3 | 7·0 | 39·38 | 11·36 | 2·12 |
| 400 | 6·7 | 7·2 | 39·03 | 11·56 | 2·20 |
| 350 | 6·6 | 7·0 | 39·35 | 10·06 | 1·89 |
| 300 | 7·0 | 7·2 | 40·43 | 9·60 | 1·88 |

| | *Dominant d.b.h.* | *Tannin content* | *Bark yield* | *Tannin yield* |
|---|---|---|---|---|
| Standard error .. .. .. .. | 0·14 | 0·66 | 0·68 | 0·10 |
| Significant difference (P=0·05) | 0·42 | 1·94 | 2·00 | 0·30 |
| Significant difference (P=0·01) | 0·57 | 2·64 | 2·72 | 0·41 |

Comparison of the mean diameters of the dominant 250 trees per acre in each treatment showed that plots at densities of 600 and more trees per acre were significantly suppressed in relation to plots at densities of 400 and fewer. This suggests that the maximum permissible density for an eleven-year rotation on this site is in the vicinity of 500 trees per acre.

The percentage tannin content of the bark showed a fairly regular decrease with increased stand density, and plots with a density of 500 trees per acre or fewer had a significantly higher tannin content than plots with a density of 650 trees per acre or more.

The highest yield of undried bark was obtained at a density of 650 trees per acre, and this was significantly higher than the yield from plots at densities of 450 per acre and less. Computed tannin yield was highest at a density of 600 trees per acre, but there was no significant difference between tannin yields over the range of densities from 550 to 700 trees per acre. It is evident, therefore, that the optimum yield lies within this range.

The density at which maximum yield may be expected was estimated at the time of harvesting the previous portion of this experiment by fitting a polynomial curve to the data (*cf. Report for 1957–1958*). It would appear, however, that this method is likely to give a satisfactory estimate only where inspection of the data suggests that they probably lie on such a curve, and then only when the estimated value falls within the actual range of treatments concerned. It is probable also that spurious results will be obtained by the use of this method in cases where mortality, resulting either from suppression or disease, causes actual densities at the time of harvesting to differ considerably from those originally prescribed. For these reasons, the use of the method has been discontinued, and optimum economic densities will be calculated in future on the basis of a combined assessment of mean dominant diameter, mean undried bark yield, and mean computed tannin yield per acre.

On this basis, it is estimated that the optimum economic density for this site at eleven years of age lies between 500 and 600 trees per acre.

Analysis of diameter measurements of the portion of this experiment which is to be harvested at thirteen years of age indicated that plots at densities of 600 trees per acre were significantly suppressed (P=0·05) in relation to plots at densities below 400 trees per acre.

(*b*) The second portion of experiment S.3 at Bloemendal (Pietermaritzburg district) was harvested in November, 1959, at nine years of age and gave the following results:

| Nominal density per acre at harvesting | Mean d.b.h. (inches) | Mean d.b.h. 400 dominants per acre (inches) | Mean percentage tannin content (moisture-free basis) | Mean undri d bark yield (long tons per acre) | Mean tannin yield (long tons per acre) |
|---|---|---|---|---|---|
| 800 | 4·6 | 5·3 | 36·85 | 11·02 | 1·97 |
| 750 | 4·7 | 5·3 | 36·30 | 10·83 | 1·92 |
| 700 | 4·7 | 5·2 | 35·80 | 9·77 | 1·71 |
| 650 | 4·8 | 5·2 | 37·65 | 9·81 | 1·85 |
| 600 | 5·0 | 5·5 | 38·00 | 9·97 | 1·88 |
| 550 | 5·1 | 5·5 | 36·65 | 9·53 | 1·73 |
| 500 | 5·3 | 5·6 | 37·33 | 9·13 | 1·67 |
| 450 | 5·4 | 5·6 | 39·73 | 8·86 | 1·76 |
| 400 | 5·5 | 5·5 | 39·28 | 8·04 | 1·57 |

| | *Dominant d.b.h.* | *Tannin content* | *Bark yield* | *Tannin yield* |
|---|---|---|---|---|
| Standard error .. .. .. .. | 0·11 | 1·04 | 0·34 | 0·07 |
| Significant difference (P=0·05) | 0·32 | 3·04 | 0·99 | 0·21 |
| Significant difference (P=0·01) | 0·43 | 4·11 | 1·34 | 0·29 |

Owing to site irregularities, no clear-cut trend in suppression relationships emerged from the analysis of mean diameters of the dominant 400 trees per acre. It would appear, however, that the maximum permissible density on this site at nine years is about 600 trees per acre.

Although the percentage tannin content of the bark suggested a rising trend with a reduction in stand density, differences in tannin percentage between treatments were not significant.

As a result of good rains in the spring, very few trees failed to strip at the time of harvesting this experiment, and plots at the maximum density tested, viz. 800 trees per acre, gave a significantly higher undried bark yield than plots with densities below 750 trees per acre.

Irregular variation in percentage tannin content over the range of treatments was probably responsible for the absence of any clear-cut trend in the computed tannin yields. Although a density of 800 trees per acre gave the highest tannin yield, the differences between this yield and those from densities of 600 and 650 trees per acre were not significant.

On the weight of evidence from the above results, it is estimated that the optimum economic density for this site at nine years of age lies between 600 and 700 trees per acre.

Analysis of the mean dominant diameters in the remaining portions of this experiment indicated that at nine years of age on this site, plots at densities of 600 per acre or more were significantly suppressed (P=0·05) in relation to plots at densities of 400 per acre or less.

(*c*) The first portion of experiment S.5 on the Clan Syndicate estate (Albert Falls district) was harvested in October, 1959, at seven years of age.

The following are the results from the harvested plots:

| Nominal density per acre at harvesting | Mean d.b.h. (inches) | Mean d.b.h. 420 dominants per acre (inches) | Mean percentage tannin content (moisture-free basis) | Mean undried bark yield (long tons per acre) | Mean tannin yield (long tons per acre) |
|---|---|---|---|---|---|
| 1200 | 4·4 | 5·4 | 30·60 | 10·82 | 1·44 |
| 1100 | 4·6 | 5·6 | 31·37 | 11·61 | 1·65 |
| 1000 | 4·8 | 5·6 | 31·97 | 11·18 | 1·58 |
| 900 | 4·9 | 5·8 | 31·20 | 10·81 | 1·47 |
| 800 | 5·0 | 5·5 | 32·07 | 9·88 | 1·51 |
| 700 | 5·3 | 5·8 | 31·10 | 9·51 | 1·37 |
| 650 | 5·0 | 5·4 | 32·97 | 8·46 | 1·26 |
| 600 | 5·4 | 5·7 | 32·90 | 9·85 | 1·48 |
| 550 | 5·7 | 5·9 | 33·73 | 9·92 | 1·50 |

| | *Dominant d.b.h.* | *Tannin content* | *Bark yield* | *Tannin yield* |
|---|---|---|---|---|
| Standard error .. .. .. .. | 0·16 | 0·53 | 0·63 | 0·10 |
| Significant difference (P=0·05) | 0·48 | 1·59 | 1·89 | 0·29 |
| Significant difference (P=0·01) | 0·66 | 2·19 | 2·61 | 0·40 |

This experiment suffered wind damage during a severe gale which took place early in 1957 and a number of trees died as a result of injuries sustained at that time. In addition, a high incidence of gummosis disease accompanied by wood-rot infection, which first became apparent when the trees were about five years old, resulted in serious mortality over most of the experimental area. In consequence, the actual densities at the time of harvesting differed considerably from the densities originally prescribed, which are shown as nominal densities in the above table. The mean numbers of trees per acre at the time of harvesting, as compared with the nominal densities were as follows:

| 1200 | 1100 | 1000 | 900 | 800 | 700 | 650 | 600 | 550 |
|---|---|---|---|---|---|---|---|---|
| 973 | 920 | 820 | 780 | 673 | 600 | 567 | 560 | 500 |

Since variations in stand form an integral part of the treatment effect, it is not practicable to use the analysis of covariance technique to compensate for differences between actual and prescribed densities. Results have been evaluated, therefore, upon the actual rather than upon the nominal densities.

Here, too, there is no clear-cut trend in suppression relationships, presumably because of considerable soil variation over the experimental area, and it is virtually impossible to determine the maximum permissible density with any degree of accuracy. It seems likely that this may lie in the vicinity of 800 trees per acre.

The percentage tannin content of the bark increased fairly regularly with a decrease in density of stand and was significantly higher in plots at densities of 570 per acre and less than in plots at densities above 920 trees per acre.

Both the highest bark yield and the highest tannin yield per acre were attained at a mean density of 920 trees per acre, but differences between the yields over the range of actual densities were not significant.

Though the above results are far from conclusive, it appears that the optimum economic density for this site at seven years of age probably lies between 800 and 900 trees per acre.

An examination of the suppression relationships in the other three portions of this experiment indicated that at seven years of age there were no significant differences in the degree of suppression in stands covering the range of densities from 200 to 850 trees per acre.

(*d*) Experiment S.34 at Bloemendal, which is similar in objective to the above experiments, showed no differences in the degree of suppression between plots over the range of densities from 300 to 700 trees per acre when re-measured in December, 1959, at four years of age.

**2. Studies in Frost Behaviour.**

Experiment S.N.2 at Vroegeveld, Piet Retief district, results from which were presented in the *Report for 1958–59*, was repeated at Groenfontein, using very much larger plots than before, since it was felt that lateral movement of air between adjacent plots might have influenced the results obtained previously.

The new site chosen for the experiment was in the centre of a large grass paddock with a slope of 2° 30′ and an aspect slightly south of east. There were no trees within 300 yards of the experimental area in any direction.

The design of the experiment was a latin square with plots just under 35 yards square (0·25 acre) and the treatments were as follows:

A. Original grass cover undisturbed.
B. Grass cover removed and surface covered with dry, wattle leaf litter.
C. Area ploughed and left rough without disc-harrowing.
D. Grass cover removed leaving a bare, hard soil surface.

Two maximum and minimum thermometers were mounted in the centre of each plot, one at a height of 2·5 cm. and the other at a height of 45 cm. above the surface of the soil. Temperature readings were taken daily over a period of 70 days from 4th June to 12th August, 1960.

The results of this temperature study are given below for comparison with those obtained previously on plots 0·025 acre in area.

| Nature of surface | Minimum daily temperature (°F.) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2·5 cm. above ground | | | | 45 cm. above ground | | | |
| | Mean | | Lowest | | Mean | | Lowest | |
| | 1959 | 1960 | 1959 | 1960 | 1959 | 1960 | 1959 | 1960 |
| A. Grass .. .. .. | 28·6 | 22·6 | 19·0 | 10·5 | 33·9 | 26·1 | 27·0 | 12·5 |
| B. Wattle leaf litter.. | 30·3 | 24·5 | 21·5 | 11·5 | 33·9 | 27·2 | 27·0 | 14·0 |
| C. Bare cultivated soil | 31·9 | 25·3 | 23·0 | 12·0 | 34·4 | 27·4 | 27·5 | 14·0 |
| D. Bare unbroken soil | 33·6 | 27·4 | 25·0 | 15·0 | 34·6 | 28·2 | 28·5 | 14·5 |
| Standard error .. .. | 0·41 | 0·31 | | | 0·12 | 0·12 | | |
| Significant difference (P=0·05) .. .. .. | 1·4 | 1·1 | | | 0·4 | 0·4 | | |
| Significant difference (P=0·01) .. .. .. | 2·1 | 1·6 | | | 0·6 | 0·6 | | |

Although mean minimum temperatures followed the same trend in both years, being always lowest over grass and successively higher over leaf litter, cultivated soil, and unbroken soil, the difference between temperatures over the litter-covered and cultivated surfaces was not significant in 1960 as it had been in 1959. This was probably due to the fact that roughly-ploughed ground in the more recent trial provided a poorer radiating surface than did the more finely broken down soil in the corresponding treatment in 1959. The differences between mean minimum temperatures over grass and unbroken soil were approximately the same in both years at the 2·5 cm. level, but were much greater in 1960 at the 45 cm. level. It is believed that the larger plot size in the more recent experiment may be responsible for this result in that it has reduced the effect of lateral air movement in causing a mixing of air and consequent equalization of temperatures over adjacent surfaces at this level.

Far from indicating any decrease, the mean temperatures again actually increased towards the 45 cm. level, but there were many more cases of decreases in individual daily readings than was the case last year. In 1959, only twenty individual cases of temperatures lower at the 45 cm. than at the 2·5 cm. level were found in a total of 928 observations, and all of these occurred over bare soil. In 1960, however, temperature decreases with height occurred in 13 per cent. of observations made over bare unbroken soil and in 0·7 per cent. over each of grass-covered, litter-covered, and cultivated soil surfaces. It is probable that the use of larger plots has made possible the detection of these differences between various radiating surfaces in their tendency to produce reversals of the normal temperature inversion phenomenon. The fact that such reversals occur with greater frequency over bare soil does not vitiate the value of clean cultivation in reducing frost injury, since differences in temperature over bare soil at the two levels are so small that the reversals are probably of little consequence.

### 3. Wattle Shelterwood Experiments.

(*a*) In Experiment S.36 at Moorburg (Estcourt district), the nurse trees were stripped standing during the summer of 1959–60 and left to provide some overhead cover during the succeeding winter. The seedling stand was thinned to 1,200 trees per acre in October, 1959, and tree heights were measured in July, 1960, at which time only occasional small seedlings were observed to have been damaged by frost.

The results of this measurement were as follows:

| Treatment | Mean height in feet | Number of seedlings per acre 10 feet and over in height |
|---|---|---|
| 60 nurse trees per acre | 11·08 | 625 |
| 80 nurse trees per acre | 10·15 | 538 |
| 100 nurse trees per acre | 9·68 | 483 |
| 150 nurse trees per acre | 9·70 | 483 |
| Standard error .. .. .. .. | 0·80 | 93 |
| Significant difference (P=0·05) | 2·75 | 320 |
| Significant difference (P=0·01) | 4·17 | 485 |

Although the tallest and best-stocked stand had developed under the most open overwood, as between the four densities there were no significant differences either in mean height of the regenerated stand or in the number of seedling trees which had reached or exceeded 10 feet in height at two and a half years of age.

Plate I illustrates the type of stand which has been produced under this regeneration system. It will be noted that height growth is not unduly irregular, despite the fact that at least two age-classes are represented in the regenerated stand; the distribution of regeneration is quite satisfactory, with no seriously understocked areas.

General view of portion of Experiment S.36 showing the nature of cover provided by the stripped nurse trees.

Close-up to show the height and satisfactory distribution of seedling regeneration in Experiment S.36.

(*b*) A runaway fire which swept through the Kambula area near Vryheid in August, 1958, destroyed a number of wattle plantations of various ages. The dense natural regeneration which appeared in the fire-killed stands provided an opportunity for studying the effectiveness of a dead overwood in controlling radiation and so preventing or reducing frost injury. On account of the small size and irregular shape of the damaged plantations, most of which were on sites subject to severe frosts, it was not possible to lay out a statistically-planned, replicated experiment to test the relative efficacy of different densities of dead overwood for this purpose. Three observation plots were, however, laid down, and the fire-killed trees in these plots were thinned so as to leave 100, 160, and 240 dead nurse trees well distributed over the area. The bulk of the dense seedling regeneration in these plots was hoed out, leaving lines of seedlings nine feet apart, and these were thinned when about eighteen inches in height to a distance of two to three feet apart in the rows. When they reached a height of six feet, the seedlings were again thinned to approximately 700 trees per acre and two years from the date of the fire had a mean height of about 12 feet. Even in the plot with the fewest nurse trees, no frost damage has occurred during the past two winters, but some seedlings in the plot with 240 nurse trees per acre have suffered stem deformation as a result of growing up through the lower branches of overwood trees. The degree of protection which the dead overwood has afforded up to two years after it was killed is borne out by the fact that well-grown regeneration in an adjoining plantation suffered serious frost damage during the past winter, following felling of the overwood trees.

It thus appears, that a dead overwood with a density as low as 100 trees per acre is capable of providing adequate protection for the regeneration of wattle in frosty areas. It is recommended, therefore, that before stripping wattle plantations in areas known to be subject to severe frosts, about 100 well-distributed, large-crowned dominants per acre should be selected and stripped standing to act as nurse trees for the regeneration of the crop when the rest of the stand is felled.

## 4. Use of Wattle in Arable Crop Rotations.

The treatments in Experiment S.40 at Bloemendal were repeated for the third time on the same plots (*Reports for 1957–1958* and *1958–1959*). Although the maize silage crop (Treatment C) was harvested in January as prescribed and the swede crop sown as soon as possible thereafter, the latter failed completely, as in 1957–58.

The results were as follows:

| Treatment | Yield lb. per acre | Equivalent per acre | Estimated net value £ per acre |
|---|---|---|---|
| A. Maize for grain | 1974·5 | 9·87 bags | 11·262 |
| B. Maize for grain | 1243·0 | 6·22 bags | 5·787 |
| C. Maize for silage | 23996·0 | 12·00 tons | 16·910 |
| Swedes | — | — | — |
| D. *Eragrostis* for hay | 10000·0 | 5·0 tons | 27·665 |

| | |
|---|---|
| Standard error | 1·996 |
| Significant difference (P=0·05) | 6·908 |
| Significant difference (P=0·01) | 10·463 |

There was a considerably lower yield of maize grain in both the A and B treatments than in the previous season. This reduction is attributed to a period of drought during January and February, which inhibited grain development, rather than to any appreciable fall in soil fertility. That depletion of potash has continued at a fairly rapid rate is borne out by the considerably lower yield of the B treatment, which received no potash. The difference in net crop value between the A and B treatments, however, was not significant.

The cash value of the maize silage would have been higher than in the previous year but for the fact that it had to be reduced by the cost of the fertilizer used on the unsuccessful swede crop. Since the silage was harvested before the mid-summer drought could affect its yield, this result confirms the supposition made above that the soil fertility of this old wattle land had not become appreciably reduced, except in respect of potash, up to this time. The cash value of the silage crop was significantly higher than that of maize grain in the B treatment and, if it had not been reduced as a result of the failure of the swede crop, would have been significantly higher than that of the A treatment as well.

The hay crop was also slightly lower than in the previous season, probably because of the mid-summer drought. Its cash value, however, was highly significantly greater than that of any of the other crops in the experiment.

These results show that cropping of old wattle land can be continued successfully for three years without addition of nitrogenous fertilizer, and that depletion of potash in the soils of the experimental area has shown up most markedly in the second and third seasons of cropping. They also confirm the conclusion reached last year that *Eragrostis* hay is likely to prove a more profitable means of utilizing the stored nitrogen in old wattle land than the growing of maize either for grain or for silage.

It is clear also that a better net return would be obtained by harvesting the silage crop in February and abandoning attempts to obtain a winter root crop on the same land.

## (b) GENETICS AND PLANT BREEDING

### 1. Interspecific Hybrids.

(*a*) *Black wattle* (Acacia mearnsii) x *green wattle* (A. decurrens). When crosses were made between green and black wattles using green as the seed parent, the $F_1$ hybrids had a rather high degree of sterility both on selfing and on backcrossing to green wattle, but they were considerably more fertile when backcrossed to black (*Report for 1950*). In 1952, the reciprocal crosses were made, black wattle being used as the seed parent, to determine whether the direction in which the cross was made had any effect on the genetical behaviour of the hybrids. During July and August, 1959, the black x green $F_1$ hybrids were selfed and backcrossed to both parent species. Seed from these pollinations was harvested during November and December, 1959. The seed set on seven trees from four different $F_1$ hybrid families is shown in the table below and for comparison a summary of the seed set from $F_1$ hybrids which had green wattle as seed parent.

*Black and green wattle hybrids. Seed set following different pollinations*

| Black x green hybrids | Selfed | | | x Green wattle | | | x Black wattle | | |
|---|---|---|---|---|---|---|---|---|---|
| | Number of pods | Number of seeds | Mean per pod | Number of pods | Number of seeds | Mean per pod | Number of pods | Number of seeds | Mean per pod |
| H1/54/39 | 126 (6) | 36 | 0·28 | 8 (1) | 0 | 0·00 | 8 (1) | 2 | 0·25 |
| H2/54/6 | 51 (7) | 1 | 0·02 | — | — | — | — | — | — |
| H3/54/20 | 16 (4) | 2 | 0·12 | 11 (2) | 1 | 0·09 | 52 (2) | 15 | 0·29 |
| H3/54/30 | 0 (3) | 0 | 0·00 | 0 (1) | 0 | 0·00 | 1 (3) | 0 | 0·00 |
| H3/54/51 | 0 (3) | 0 | 0·00 | 0 (2) | 0 | 0·00 | 0 (3) | 0 | 0·00 |
| H3/54/55 | 27 (5) | 7 | 0·26 | 5 (2) | 1 | 0·20 | 21 (1) | 6 | 0·29 |
| H3/55/39 | 140 (10) | 39 | 0·28 | — | — | — | — | — | — |
| | 360 (38) | 85 | 0·21 | 24 (8) | 2 | 0·08 | 82 (10) | 23 | 0·28 |
| Green x black hybrids | 612 (35) | 497 | 0·81 | 17 (3) | 25 | 1·47 | 236 (9) | 957 | 4·05 |

Figures in brackets give the number of inflorescences.

From these figures, it would seem that when black wattle is the seed parent, the $F_1$ hybrids are more sterile than the opposite cross. The difference observed may, however, lie in the characteristics of the particular trees used in the cross. Because of the difficulty in finding trees of the two species whose flowering time coincided, all the black x green hybrid families had a common seed parent (B5), but different green wattle pollen parents. This tree may have been the cause of low fertility, and unless data can be obtained from a wider range of hybrids, it is not possible to say how far differences in fertility depend on the direction of the cross.

(*b*) *Seed-maturing period of hybrids.* Green wattle flowers in July and August and the seed ripens in 4-6 months, whereas black wattle flowers in September and October, but the seed does not ripen until 12-14 months later. The shorter seed-ripening period of green wattle is completely dominant in hybrids between the two species, irrespective of the direction in which the cross is made, and it appears to be controlled by two major genes. A backcrossing programme was started in 1950 to try to incorporate the shorter seed ripening period into black wattle and has now reached the stage of the second backcross to that parent. Trees in this backcross generation flower in September-October as does black wattle.

Seed ripening was recorded in the second backcross families in the 1958–59 season, but irregular and unseasonable flowering made recording difficult. In the 1959–60 season, flowering was normal, and the date of full flush of each tree and the stages of subsequent pod development were recorded.

A number of trees, like green wattle, produce ripe pods in 4–6 months from flowering, while others ripen seed in 12–14 months like black wattle. There is, however, a considerable proportion of the trees which it is difficult to assign to either category. On the same tree, some pods may grow quickly and mature like green wattle, while others, like black, remain small for several months before expanding and maturing. A similar mixture of small and large pods has occasionally been observed in black wattle, but usually as a result of injury or disease.

Two possibilities to account for the mixed seed-ripening behaviour in backcrosses come to mind. First, that the dominant green wattle genes for quick ripening lose expressivity as the black-wattle genetic background is increased, and secondly, that the combination of late flowering and short seed-ripening period causes maturation to take place at an unfavourable time of the year. This second possibility suggested that a survey of flowering times and seed maturity in the *decurrens* group of acacias might be of interest. Through the kindness of Miss M. Tindale, of the Royal Botanic Gardens, Sydney, New South Wales, flowering times and seed ripening periods have been obtained for 14 species of this group. Of these species, nine flowered between July and September and all these matured seed in 4–6 months. The remaining five species flowered between October and December and in all these, maturation was delayed, seed ripening taking place 12–14 months later. It seems, therefore, that time of flowering and maturation period of seed are related and that the unusual combination of late flowering and early maturation in backcrosses may result in a gene-environmental interaction causing failure of clear-cut segregation.

## 2. Inbred Lines of Black Wattle.

Inbred ($S_1$) lines planted in 1954 and 1955 differed significantly in susceptibility to gummosis and black butt (*Report for 1958–1959*). These families were checked again and a number of trees selected for propagation. Selection was rigorous and only nine trees were found which combined freedom from disease with other requirements. All these trees were successfully propagated by means of air-layers put on in January, 1960, and clones of four or five individuals from each tree are available for interplanting or intercrossing in due course. One $S_1$ family was outstanding in that it combined exceptionally good form and vigour for an inbred line with a relatively low incidence of gummosis.

Intercrosses were made on clonal material of eight trees selected in $S_1$ inbred lines for high tannin content or low incidence of disease.

### 3. Intercrossing Selected Trees of Black Wattle.

Preliminary screening by progeny trials has led to the isolation of a number of parent trees with good characteristics such as high tannin content, low susceptibility to disease, or good tree form. During September and October, 1959, a programme of intercrossing was carried out on clones which had been propagated by air-layers. When selecting trees for intercrossing, emphasis was placed primarily on high tannin in the bark or on resistance to disease, and the trees were divided into two groups on this basis.

In the high tannin group, there were eleven trees and, ignoring reciprocal crosses, 37 of the possible 54 cross-pollinations were made. In the disease resistance group, there were seven trees and all possible 21 cross-pollinations were made. All the trees inter-crossed were also self-pollinated to produce new inbred lines.

The intercrossing programme was carried out under favourable conditions, but towards the end of March, 1960, a severe storm destroyed three of the trees and damaged others, but fortunately a good proportion of the bagged branches escaped serious damage. Since black wattle takes 12–14 months to mature seed, success of the programme in terms of seed yield is not yet known.

### 4. Progeny Testing and New Accessions.

The progeny trial planted during the previous season (5th January, 1959) was scored for height in January, 1960, and significant differences between families were found. This trial included 19 families of black wattle and one family of *A. silvestris*, another promising species, all from seed collected by Mr. S. P. Sherry in Australia in 1957. There were also 28 families from local selections of black wattle and one of commercial seed.

*A. silvestris*, which is a vigorous tree in Australia, has made poor growth. With one exception, the families from Australian seed were, on the whole, not as good as local families.

Of the accessions from Australia, a number had been collected from the colder parts of the black wattle range with a view to obtaining types likely to have frost resistance. Twelve families of seedlings most likely to show such resistance were grown in paper pots and sent to the Eastern Transvaal area, where they were planted under the care of the Assistant Silviculturist on a typical frosty site. Records made at the end of the cold season showed significant differences between the families in height, but although there were considerable differences in the number of seedlings damaged by frost, and in the degree of damage, these did not reach the level of significance. In spite of this, there is reason to believe that the families have shown differences in susceptibility to frost damage and the results are considered to be of sufficient promise to warrant further trials.

Routine recording was carried out in some of the older progeny trials. These continue to show differences in form, vigour, and disease resistance and to serve as a basis for selection of parent trees.

The first progeny trial planted in December, 1950, was due for harvesting during the 1959–60 season, but, because of difficulties in arranging the general felling programme, a start could not be made until 1st March, 1960. Owing to unseasonably dry weather, stripping was difficult, and when 15 of the 150 plots had been felled, it became evident that the remainder would have to be left over until the 1960–61 season. Fortunately, the results of the experiment as a whole are unlikely to be seriously affected.

### 5. Vegetative Propagation.

It has been mentioned (*Report for 1958–1959*) that Mr. R. J. Garner and Dr. A. B. Beakbane of the East Malling Research Station, Kent, had kindly offered to assist with the vegetative propagation problem, and during the year, reports were received on the progress of the work.

Mr. Garner, using young black wattle trees grown from seed supplied by the Institute, has been successful both in rooting cuttings and in making grafts without undue difficulty. He stresses, however, that the material used was about eight months old and in the juvenile phase, and that this phase is invariably associated with high regenerative capacity; the propagation and grafting of shoots from mature trees may prove to be a more difficult proposition. Mr. Garner has again kindly offered to try to propagate shoots from mature trees, and material has been sent to him for this purpose.

Dr. Beakbane's findings were not so encouraging. From histological examination of shoots sent to her from six one-year-old trees, she concluded that they would probably be difficult to propagate by cuttings or layers, more especially as the shoots were from comparatively young trees. In most plants, there is a considerable change in anatomy and ease of rooting with age.

Meanwhile, propagation of selected trees by air-layering was continued. During the season, 187 air-layers were put on 57 trees and of these, 87 per cent. rooted. On only 3 trees did all layers fail to root, and 2 of these were trees in the middle of a nine-year-old plantation growing under rather dry conditions. Rooting in this area was very slow, layers taking 10-15 months to form roots as against an average time of some six months in younger plantations. Nevertheless, in spite of this slowness, 71 per cent. of the layers eventually rooted. There was no significant difference in the percentage rooting between layers on trees from open-pollination and those on less vigorous trees resulting from self-pollination.

### 6. Pollination Mechanism.

Following preliminary tests to determine to what extent wattle is wind-pollinated (*Report for 1958–1959*), a more detailed trial was started in September, 1959. Well-grown, flowering, clonal material from five selected trees was chosen for the trial, trees known to carry a recessive character being used where possible. Fourteen to 18 inflorescences of approximately equal size had all open flowers and most of the leaves removed. Four inflorescences on each tree were enclosed in cages made of nylon mesh which excluded large insects, but not wind-borne pollen, four more were left uncovered, and the remainder covered with Cellophane bags which excluded both insects and pollen.

In December, 1959, a count was made of the number of pods. The average number per inflorescence was very much higher on the uncovered (63·0) than on either bagged (26·6) or caged (17·4) branches. Pod counts give only a rough estimate of fertility, since it is usual for many pods to be shed, especially on selfed inflorescences, but it seems that exclusion of large insects has been effective in reducing cross-pollination. It is hoped that when the seeds are harvested in November and December, 1960, the differences will be more clear cut and that from the segregation of recessive factors, it will be possible to estimate the percentage natural crossing. Unfortunately, one of the trees which was known to carry a clear cut recessive character was destroyed by the storm in March, 1960.

### 7. Tetraploidy.

An account of the induction and behaviour of tetraploids is given on page 32 of this Report.

## (c) CHEMISTRY

### 1. Fertilizer Experiments.

(*a*) *Major factorial experiments.* The second of these experiments was laid down at Bloemendal in 1950 on soil derived from shale and was harvested in December, 1959. The treatments were:

| *Nitrogen* | *Phosphorus* | *Potassium* | *Lime* |
|---|---|---|---|
| $N_0$ Nil | $P_0$ Nil | $K_0$ Nil | $L_0$ Nil |
| $N_1$ 1 cwt./acre | $P_1$ 2 cwt./acre | $K_1$ 1 cwt./acre | $L_1$ 2½ tons/acre |
| $N_2$ 2 cwt./acre | $P_2$ 4 cwt./acre | $K_2$ 2 cwt./acre | $L_2$ 5 tons/acre |

N = ammonium sulphate
P = superphosphate
K = muriate of potash
L = agricultural lime.

The mean yields of undried bark, oven-dried bark, and tannin in long tons per acre are given in the following table:

| Treatment | Undried bark | | Oven-dry bark | | Tannin | |
|---|---|---|---|---|---|---|
| | Tons per acre | Significant difference | Tons per acre | Significant difference | Tons per acre | Significant difference |
| $N_0$ | 9·28 | Not significant | 4·87 | Not significant | 1·80 | Not significant |
| $N_1$ | 9·37 | | 4·86 | | 1·79 | |
| $N_2$ | 9·09 | | 4·78 | | 1·76 | |
| $P_0$ | 8·52 | 0·64 | 4·42 | 0·14 | 1·64 | 0·18 |
| $P_1$ | 9·65 | | 5·06 | | 1·88 | |
| $P_2$ | 9·57 | | 5·04 | | 1·85 | |
| $K_0$ | 8·57 | 0·66 | 4·50 | 0·15 | 1·66 | 0·18 |
| $K_1$ | 9·41 | | 4·93 | | 1·82 | |
| $K_2$ | 9·76 | | 5·09 | | 1·88 | |
| $L_0$ | 8·86 | Not significant | 4·67 | Not significant | 1·75 | Not significant |
| $L_1$ | 9·35 | | 4·89 | | 1·80 | |
| $L_2$ | 9·53 | | 4·95 | | 1·82 | |

In this experiment, both phosphate and potash produced significant increases in yield. The increase in yield of undried bark as a result of the application of 2 cwt. per acre of superphosphate was 1·13 ton, which at £7 10s. 0d. per ton is worth about £8 10s. 0d. With superphosphate at £12. 0s. 0d. per ton on the farm and labour for application at 4s. 6d. per acre, the cost of a 2 cwt. dressing is £1. 8s. 6d. per acre, representing a net gain of just over £7. 0s. 0d. per acre.

A double dressing of superphosphate did not increase the yield over that obtained from the 2 cwt. dressing.

With potash, the increase in yield from a dressing of 1 cwt. per acre was 0·84 ton of undried bark, worth £6. 6s. 0d. The cost of muriate of potash on the farm was about £23 per ton, and again allowing 4s. 6d. per acre for application, the total cost per acre was £1. 7s. 6d., showing a net gain of nearly £5 per acre.

There were no significant interactions between treatments.

As in the case of the experiment on Table Mountain Sandstone, the results calculated from annual measurements agree well with those from the final harvest except in the case of lime, which showed no significant improvement at final harvest.

The stand in the limed plots was more uneven than elsewhere, but even when allowance is made, the treatment is not significant.

*Annual estimates of treatment effects compared with actual yields at harvest*

(No treatment = 100)

| Year | Nitrogen | Phosphorus | Potash | Lime |
|---|---|---|---|---|
| 1951† .. | 103 | 110* | 99 | 90 |
| 1952† .. | 102 | 109* | 104* | 100 |
| 1953† .. | 102 | 109* | 104 | 100 |
| 1954† .. | 100 | 105* | 102 | 101 |
| 1955†† .. | 99 | 113** | 110** | 107** |
| 1956†† .. | 100 | 114** | 111** | 107* |
| 1957†† .. | 100 | 115** | 114** | 110** |
| 1959‡ .. | 98 | 114** | 113** | 106 |

†Based on height only.
††Based on estimated bark weight calculated from height and diameter measurements.
‡Based on actual weight at harvest.
*Difference significant (P=0·05).
**Difference significant (P=0·01).

The third experiment of this series, on soil derived from dolerite, suffered serious wind damage some years ago and height records are unreliable. The experiment suffered another serious blow this year when portions of two plots were felled by the owners without prior reference to the Institute. It is unlikely, therefore, that pre-harvest estimates will match the final harvest results as closely as in the other two factorial experiments already harvested. The estimates given below are based on a regression of yield on diameter.

*Estimated mean bark weight in relation to treatment*

(No treatment = 100)

| Soil-parent material | Nitrogen | Phosphorus | Potash | Lime |
|---|---|---|---|---|
| Dolerite .. | 102 | 109* | 100 | 107 |

*Difference significant (P=0·05)

(*b*) *Different forms of phosphate.* In these experiments, different forms of phosphate fertilizer were compared to find out if less soluble forms are as beneficial on acid soils as superphosphate.

The first experiment, at Bloemendal, on soil derived from shale, was harvested this year with the following results:

| Treatment | Mean yield in long tons per acre | | |
|---|---|---|---|
| | Undried bark | Oven-dry bark | Tannin |
| Superphosphate .. .. .. .. .. .. | 8·82 | 4·43 | 1·630 |
| Super-raw (3:1) .. .. .. .. .. .. | 8·09 | 4·08 | 1·485 |
| Langfos .. .. .. .. .. .. .. | 7·85 | 3·98 | 1·500 |
| Moroccan rock .. .. .. .. .. .. | 7·97 | 4·03 | 1·487 |
| Calcium metaphosphate .. .. .. .. | 7·90 | 4·01 | 1·498 |
| Significant difference (P=0·05) .. .. | Not significant | 0·33 | 0·103 |

Superphosphate just failed to reach significance on undried bark weight, but was significantly better than other forms of phosphate both on oven-dry weight and on the yield of tannin per acre.

The other experiment, on dolerite, showed no significant differences on estimated yields. This experiment is due to be harvested in 1962.

(*c*) *Quantity of superphosphate and method of application.* In this experiment, six rates of application of superphosphate are combined with four methods of application. The rates are 0, 50 lb., 100 lb., 200 lb., 400 lb., and 800 lb. per acre.

The methods of application are:

A. Half under the seed before sowing; remainder between the lines one year later.
B. Half in bands on either side of the seedling lines at first thinning; remainder between the lines one year later.
C. All under seed before sowing.
D. All in bands on either side of the seedling lines at first thinning.

The design of the experiment is a 4 x 4 latin square for methods of application with plots split for rates.

*Estimated undried bark weight (long tons per acre) at 6 years*

| Treatment | Superphosphate lb./acre | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 50 | 100 | 200 | 400 | 800 | Mean |
| A | 5·55 | 5·84 | 5·77 | 6·31 | 6·23 | 6·53 | 6·04 |
| B | 5·40 | 5·59 | 5·67 | 5·66 | 6·50 | 6·42 | 5·87 |
| C | 5·78 | 5·48 | 6·01 | 6·68 | 7·14 | 6·90 | 6·33 |
| D | 5·84 | 5·72 | 5·56 | 6·15 | 6·54 | 6·71 | 6·09 |
| Mean | 5·64 | 5·66 | 5·75 | 6·20 | 6·60 | 6·64 | 6·08 |

| | *Quantity* | *Method of application* |
|---|---|---|
| Standard error .. .. .. .. .. .. .. | 1·270 | 1·275 |
| Significant difference (P=0·05) .. .. .. | 0·69 | 0·29 |
| Significant difference (P=0·01) .. .. .. | 1·05 | 0·39 |

There was a marked response to quantity of superphosphate, with the optimum economic dressing at just over 200 lb./acre. There were no significant differences between methods of application.

(*d*) *Gummosis.* Once again, scoring of all fertilizer experiments for incidence of gummosis revealed no significant differences due to fertilizer.

## 2. Bark Analysis.

*Routine analysis.* During the year, 695 bark samples were analyzed, most of them being samples taken during the harvesting of field experiments on the lines indicated in last year's *Report.* The number of plots harvested, sampled, and analyzed was 215 and in all cases duplicate samples were taken. The results indicate that the sampling methods were adequate.

This method of harvesting and sampling, however, makes extremely heavy demands upon the staff both in numbers and in the intensity of operations during the limited period available. A less laborious method is, therefore, being investigated and will be compared with the present system during the coming season.

In addition, 71 samples were analyzed for the Government Inspector of Wattle Bark and, in a large majority, the analytical results supported the visual grading.

## 3. Variation in Percentage of Tans and Non-Tans with Age.

Details of the experimental layout and method of harvesting at six-weekly intervals were given in the *Report for 1957–1958.* The average measurements of the trees harvested at three, four, and five years of age are given below:

| | 3 *years* | 4 *years* | 5 *years* |
|---|---|---|---|
| D.B.H. (inches) .. .. .. | 3·0 | 3·7 | 4·2 |
| Height (feet) .. .. .. .. | 31·2 | 37·7 | 44·0 |
| Dry bark weight (lb.) .. .. | 4·0 | 7·6 | 11·0 |

The analytical figures covering the three year period are shown in the following table; the tan and non-tan figures are the average of four plots harvested at the same time:

| Time | Tan per cent. | | | Non-tan per cent. | | | Tan/non-tan ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3 years | 4 years | 5 years | 3 years | 4 years | 5 years | 3 years | 4 years | 5 years |
| October .. | 35·4 | 36·2 | 36·6 | 14·3 | 16·2 | 16·7 | 2·5 | 2·2 | 2·2 |
| November .. | 36·0 | 36·0 | 38·1 | 12·9 | 14·4 | 14·9 | 2·8 | 2·5 | 2·6 |
| January .. | 34·6 | 37·5 | 37·4 | 13·0 | 13·1 | 15·3 | 2·7 | 2·9 | 2·4 |
| February .. | 35·3 | 35·4 | 38·2 | 12·5 | 14·0 | 14·7 | 2·8 | 2·5 | 2·6 |
| March .. .. | 33·0 | 35·8 | 37·5 | 14·5 | 14·7 | 15·0 | 2·3 | 2·4 | 2·5 |
| May .. .. | 32·6 | 36·0 | 37·4 | 14·9 | 14·8 | 14·3 | 2·2 | 2·4 | 2·6 |
| Mean .. .. | 34·5 | 36·1 | 37·5 | 13·7 | 14·5 | 15·1 | 2·6 | 2·5 | 2·5 |

The difference in tan percentage for the three years is significant ($P = 0·01$). In the case of the non-tans the results are similar to those reported last year (*Report for 1958-1959*), differences between years and between harvestings being significant ($P = 0·01$) with interaction between years and harvestings.

The rainfall figures in millimeters recorded at a weather station near the experimental area are given in the following table:

| | *3rd Year* | *4th Year* | *5th Year* |
|---|---|---|---|
| August .. .. .. .. .. | 39·3 | 10·6 | 7·6 |
| September .. .. .. .. | 163·4 | 67·1 | 47·2 |
| October .. .. .. .. .. | 206·6 | 43·7 | 120·9 |
| November.. .. .. .. .. | 74·8 | 179·2 | 109·4 |
| December.. .. .. .. .. | 89·0 | 189·2 | 101·8 |
| January .. .. .. .. .. | 157·5 | 185·8 | 78·0 |
| February .. .. .. .. .. | 178·3 | 139·4 | 122·1 |
| March .. .. .. .. .. | 55·7 | 63·5 | 99·6 |
| April .. .. .. .. .. .. | 142·9 | 58·6 | 117·0 |
| Total .. .. .. | 1,108·1 | 937·1 | 803·6 |

Previous work has shown that non-tan percentage and rainfall are highly correlated (*Report for 1956–1957*) and any age effects are, therefore, obscured.

**4. Trace Element Experiment.**

Owing to the extensive harvesting operations, it was not possible to begin these experiments, but plans are in hand to make a start during the coming season.

## (d) ENTOMOLOGY

**1. Population Study.**

Degrees of bagworm infestation in the second 10-year cycle were determined in seven plantations over an area of approximately 400 acres.

**2. Effect of Bagworm Attack on Increment.**

The increment plots were checked, data recorded, and, where necessary, plots sprayed with insecticide. Plots at Bloemendal which were heavily infested with bagworms at the age of 5 years and moderately infested at the age of 6 years were harvested and the bark weighed. Loss of increment due to defoliation amounted to nearly 0·75 ton of green bark per acre.

### 3. Chemical Control.

(*a*) *Commercial spraying campaign 1959–1960.* Over 7,000 acres were surveyed and some 5,800 selected for aerial treatment. In all, 6,142 acres were sprayed and the execution of the application supervised over 4,700 acres. The insecticide used was toxaphene dissolved in light diesel oil at the rate of 0·75 lb. in 1 gallon of solution, and 1,955 acres were treated with 2 gals./acre and the remainder with 3 gals./acre. The campaign started on 9th and ended on 30th November, 1959. In all, there were 14 spraying days with an average daily total of some 440 acres.

The general outcome of the spraying was satisfactory where plantations were properly flagged. Parts of some plantations showed an unsatisfactory kill mainly due to a very dense bagworm population.

(*b*) *Effect of insecticidal spraying on wattle insects other than bagworm.* The window flight traps in the Eston area have been dismantled and the results are being assessed.

### 4. Biological Control (Virus Diseases of Bagworms).

(*a*) *1955, 1956, and 1957 experiments.* The long-term effect of the virus treatment in plantations where the experiments were carried out is being studied.

(*b*) *1958 experiments.* The outcome of these experiments was assessed and it was found that with a light infestation in the first year of the prodromal stage and the larvae newly-hatched or in their second or third instar at the time of treatment, bagworm viruses from plantations far distant (160 to 200 miles) from the experimental areas caused a significantly higher mortality throughout than did any others. Viruses from plantations at intermediate distances (20 to 40 miles) initially gave a greater kill than did local virus or that from the thornveld, while the virus of the bollworm (*Heliothis armigera* (Hbn.) ), though giving a kill higher than in untreated plots up to 3 months after spraying, was less effective than any bagworm virus. With a heavy infestation in the second year of the prodromal stage and the larvae in the first instar at the time of spraying, mortality was significantly higher only initially with virus from the greatest distance than with any other bagworm virus. In later evaluations, there was no significant difference in any of the treatments with bagworm viruses, and throughout they were more effective than virus from the cotton bollworm. These results suggest that different strains of the virus exist and that a given population of bagworms differs in its susceptibility to these virus strains. Details of this experiment have been published (Ossowski, 1960).

(*c*) *1959 experiments.* In a detailed extension of the experiment carried out in 1958, viruses from two different sources only, applied at various stages of the development of larvae, were compared over a range of four concentrations. The assessment of the outcome is in progress and appears to confirm the result of the earlier experiment with regard to variation in virulence of the bagworm virus.

### 5. Identification of Wattle Insects.

Four insects hitherto not recorded as wattle pests were observed and identified. They are listed under Nos. 12, 14, 16, and 17 in the article on page 44 of this report.

### 6. Records of Insect Outbreaks.

The records at present contain data concerning 61 species on 257 farms.

### 7. Wattle Insect Collection.

The collection of wattle insects now contains over 260 species.

## REFERENCE

Ossowski, L. L. J. (1960). Variation in virulence of a wattle bagworm virus. *J. Insect Pathol.*, **2**, 35–43.

## (e) MISCELLANEOUS

### 1. Weed Control by Chemical Means.

Further work on the control of aspen (probably *Populus canescens*, not *P. tremula* as previously supposed) on the whole confirmed the effectiveness of 2:4-D in diesel oil as a basal spray, but there were some inconsistencies. The results with 2:4:5-T still appear to be perfectly satisfactory.

During the past year, a marked seasonal effect became apparent. In the drier conditions that prevailed, as compared with previous seasons, the reaction of the trees to treatment, notably in the swelling and pulpiness of the stem tissues, was much less obvious. The net result, however, as judged six months later, was much the same as in earlier years.

### 2. Collaboration with other Organizations.

(*a*) *Studies on the tannins of wattle species.* Samples of bark from green and black wattle trees were collected and supplied to the Leather Industries Research Institute for analytical studies.

(*b*) *Wattle timber investigations.* Wattle timber samples were supplied to the National Chemical Research Laboratory for investigations under the South African Wattle Growers' Union Timber Research Fellowship.

(*c*) *Survey of wattle products.* Samples of wattle leaves, bark, roots, seeds, and gum were collected for examination by the Tropical Products Institute in London. This investigation forms part of the new wattle research project financed by the Wattle Industry Publicity Fund; its object is to examine all possible new uses for wattle products of every kind.

# PROGRESS REPORTS AND PAPERS

## INDUCED TETRAPLOIDY IN BLACK WATTLE (*ACACIA MEARNSII* DE WILD.)

By A. A. MOFFETT and KATHLEEN M. NIXON

Tetraploidy has been induced in black wattle by treatment of the seed with colchicine solutions. The most suitable concentration of colchicine appears to be 0·02–0·03 per cent. for 24 hours treatment or 0·01–0·02 per cent. for 48 hours. Tetraploids can be distinguished from diploids by measurements, at an early stage, of stomata and, later, of pollinia. The overall vigour of tetraploids is very much less than that of diploids and many trees lack apical dominance, resulting in much-branched crowns or, in extreme examples, large, spreading bushes. Bark thickness and tannin content in tetraploids is, on the average, greater than in diploids, but because of lack of vigour, the yield of tannin per acre would almost certainly be less. Possibly if tetraploidy were induced on a wider scale and in selected trees, better basic material for selection might be obtained.

Tetraploidy has been induced in a number of crop plants with a view to producing improved varieties, but the results, on the whole, have been disappointing. Auto-tetraploidy usually causes a decrease in fertility, and in crops where the seed is harvested, it is likely to bring about a decrease in yield also. In wattle, the commercial crop consists of bark and timber, and some reduction in fertility would not be a very important factor. On the other hand, it was believed that tetraploids might be superior to diploids in some desirable characteristics. This belief was strengthened by the fact that tetraploidy not only causes giantism of morphological characters, but may also increase the percentage of some particular chemical component in the plant (Randolph 1941). Thus, from the general behaviour of tetraploids, there seemed to be a fair possibility that bark thickness and tannin content would be greater in tetraploid than in diploid wattles.

Tetraploidy was induced by treatment with colchicine, but as the approach at this stage was purely exploratory, no very detailed investigation was made. There are, therefore, many gaps in the work, and in view of the general outcome, no attempt has been made to fill them.

### Induction and Identification of Tetraploids.

Wattle seeds are hard-coated, and before germination will take place, they have to be made permeable to water, usually by treatment with hot water, but some form of scarification of the seed coat gives equally good results. The first attempts to produce tetraploids in wattle were made by Philp and Sherry in 1944 (unpublished), when they applied colchicine solutions to moist seeds first made permeable by treatment with boiling water. As far as could be ascertained, no tetraploids resulted, possibly because the colchicine did not enter the cells with the first intake of water, as appears to be necessary (Anon. 1944).

In 1948, a further series of treatments was started, the seeds being rendered permeable by removal of a small chip from the distal end so that dry seeds could be placed

in the colchicine solutions. In the first series of treatments, colchicine solutions ranging from 0·06 to 1·00 per cent. were tried, but these concentrations were too high and from 240 seeds treated, only two weakly seedlings survived. During 1949 and 1950, treatments ranging from 0·01 to 0·07 per cent. colchicine were tried and at these concentrations, the survival rate was considerably higher. After treatment, the seeds were washed and then germinated on damp cotton wool in Petri dishes. The most obvious effect of the treatment was partial inhibition of root growth, accompanied by swelling and distortion, the degree of inhibition being conditioned by the concentration of the solution and the duration of the treatment.

Following treatment with 0·01 per cent. colchicine for 24 hours, the majority of seedlings grew normally, but a few with somewhat retarded growth occurred. At the same concentration for 48 hours, the effect was more marked, but the growth of the seedlings, on the whole, was vigorous compared with that following treatment with higher concentrations. In concentrations from 0·02–0·04 per cent., the radicle grew to a length of about 10 mm. and then became swollen, further growth in length ceasing for several days. After a period varying from 7–14 days, root growth was renewed in many seedlings and these were transferred to pots and eventually planted out in the field. Between 0·05 and 0·07 per cent. concentrations, although root growth was largely inhibited, a number of seedlings produced new roots and survived, but many of them were weakly. In concentrations higher than 0·07 per cent., root growth was almost completely inhibited and the seedlings died. In the higher concentrations of colchicine, the degree of inhibition and distortion of root growth did not differ noticeably between the 24 and 48 hour treatments, but the final viability of seedlings was lower following the longer treatment (Table I).

TABLE I

*Percentage of seedlings surviving to planting in the open following colchicine treatments*

| Duration of treatment | Year | Colchicine % | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0·01 | 0·02 | 0·03 | 0·04 | 0·05 | 0·06 | 0·07 |
| 24 hours .. .. | 1948 | 35·0 | 30·0 | 15·0 | 8·3 | 8·3 | 2·7 | — |
| | 1949 | 73·0 | 43·0 | 27·0 | — | — | — | — |
| | 1950 | — | 27·0 | 18·0 | 24·0 | 5·0 | 6·0 | 2·0 |
| | Mean | 54·0 | 33·3 | 20·0 | 16·2 | 6·7 | 4·4 | 2·0 |
| 48 hours .. .. | 1948 | 28·3 | 36·7 | 11·7 | 10·0 | 3·3 | — | — |
| | 1949 | 44·0 | 46·0 | 17·0 | — | — | — | — |
| | 1950 | — | 26·0 | 13·0 | 8·0 | 3·0 | 1·0 | 0·0 |
| | Mean | 36·2 | 36·2 | 13·9 | 9·0 | 3·2 | 1·0 | 0·0 |

As the seedlings grew older, some were normal in appearance, while others had coarser, thicker leaves and larger flowers than is usual in diploids. The distinction, however, was not always clear-cut. Chromosome counts of some of the abnormal seedlings proved that they were tetraploid, but this method of identification was too tedious and, as a possible alternative, measurements of stomata and pollinia were made on most of the treated trees when they were about four years old. At the same time, similar measurements were made in diploid trees in neighbouring plantations of the same age. The measurements showed that treated seedlings fell into two fairly clear-cut groups differing ($P = < 0 \cdot 01$) in stomata and pollinia size. In one group, the measurements were very close to the diploids, but in the other, presumably tetraploid, group, both stomata and pollinia were much larger than normal (Table II). There were, however, some trees which were difficult to assign to either group with any degree of confidence.

TABLE II

*Dimensions, in microns, of stomata and pollinia in diploid and in colchicine-treated trees*

| | Stomata | | Pollinia | |
|---|---|---|---|---|
| | Length | Width | Length | Width |
| Diploid .. .. .. | 26·5±2·2 | 15·9±1·9 | 44·8±2·1 | 40·9±2·4 |
| Treated, normal.. .. | 28·3±2·4 | 16·3±2·2 | 44·0±3·6 | 40·6±2·6 |
| Treated, abnormal .. | 34·2±2·7 | 18·7±2·3 | 55·8±3·9 | 49·6±2·6 |

Chromosome counts confirmed that trees having the larger stomata and pollinia were tetraploid, but in some trees, there was inconsistency between the two sets of measurements; trees having stomata within the tetraploid range and pollinia of the diploid size, and vice versa, were found. The most likely explanation of this inconsistency is that such trees were mixoploid, part being diploid and part tetraploid. That such a condition occurred was confirmed by chromosome counts in one tree and, later, by the occurrence of both diploids and tetraploids in the progeny of some trees. Measurements of stomata and pollinia were made in 10 treatments involving a total of 59 trees of which 22 were found to be tetraploid (or partly tetraploid) and 37 diploid.

A reasonable balance between survival and tetraploidy appears to result from treatment with 0·02–0·03 per cent. colchicine for 24 hours or 0·01–0·02 per cent. for 48 hours.

**The Relative Fertility of Diploids and Tetraploids.**

No very satisfactory method of measuring fertility in wattles has been found, but for all practical purposes the number of sound seeds formed per pod gives a fairly good comparative estimate. The mean numbers of seeds set per pod, recorded in a number of the induced tetraploids in the years 1952 and 1953 following both open- and self-pollination, are shown in Table III, together with such diploid data as were available for the same years.

TABLE III

*Mean number of seeds per pod in diploids and tetraploids in the years 1952 and 1953*

| | 1952 | | | 1953 | | |
|---|---|---|---|---|---|---|
| | Number of trees | Number of pods | Mean seed per pod | Number of trees | Number of pods | Mean seed per pod |
| | Self-pollination | | | | | |
| Diploid .. .. .. .. | — | — | — | 11 | 444 | 2·51 |
| Tetraploid .. .. .. | 3 | 131 | 2·44 | 6 | 169 | 2·79 |
| | Open-pollination | | | | | |
| Diploid .. .. .. .. | 46 | 2170 | 8·02 | 26 | 1252 | 8·99 |
| Tetraploid .. .. .. | 11 | 642 | 2·39 | 11 | 464 | 4·88 |

There were no selfed diploids available for comparison in 1952, but records over a number of years show that the mean number of seeds per pod approximates very closely to 2·50. There is thus little difference in fertility between diploids and tetraploids following self-pollination, but in tetraploids, following open-pollination, it is little more than half that in diploids. The difference in seed-set in tetraploids in the years

1952 and 1953 following open-pollination may be purely seasonal; further, in 1952, the trees were too young to produce a large number of flowers and this may have affected the amount of cross-pollination. There was no significant difference in germination between diploid and tetraploid seeds.

**The Identification of Tetraploids in the Progeny of Treated Trees.**

Because of the occurrence of mixoploidy in treated trees, there was the possibility that seed collected from them would be either diploid or tetraploid. Further work was carried out, therefore, to determine how much reliance could be placed on measurements of stomata as a criterion of tetraploidy, more especially at a very early stage in growth.

Twenty-five open-pollinated seeds were collected from each of eight treated trees, six of which were known by chromosome counts to be tetraploid and two diploid. The weight of each seed was recorded before sowing. As soon as the first seedling leaf on each plant had fully expanded, one pinnule was removed from it and the length and width of ten stomata measured with a microscope fitted with a micrometer eyepiece. At a later stage, chromosome counts in acetic-orcein squashes were made wherever possible, i.e. in 99 of the 113 surviving seedlings in the six tetraploid families. When the chromosome counts were completed, the seedlings were planted out in the open and four years later, when the trees came into flower, the pollinia were measured. Because of lack of space, the diploid families were not planted out, diploid pollen previously measured being taken as a standard for comparison. A summary of these measurements is given in Table IV.

TABLE IV

*Seed weight, stomata size (first seedling leaf), and pollinia size in diploid and tetraploid progeny*

| Family from | Mean seed weight (mg.) | Stomata (microns) | | | Pollinia (microns) | | |
|---|---|---|---|---|---|---|---|
| | | No. of trees | Length | Width | No. of trees | Length | Width |
| | Tetraploid | | | | | | |
| 17/48/8 .. | 26·1±3·7 | 19 | 43·6±2·1 | 24·4±1·2 | 4 | 51·8±2·4 | 47·8±0·8 |
| 19/48/1 .. | 22·0±2·5 | 18 | 41·9±1·5 | 26·4±1·3 | 5 | 54·3±1·9 | 50·3±1·5 |
| 19/48/17 .. | 19·8±3·3 | 21 | 41·4±1·7 | 24·7±1·5 | 3 | 52·1±2·6 | 47·1±2·4 |
| 19/48/19 .. | 16·5±2·6 | 20 | 40·7±1·7 | 25·0±1·4 | 11 | 51·9±1·2 | 48·6±0·8 |
| 25/48/5 .. | 15·6±3·0 | 19 | 37·6±4·6 | 23·2±2·4 | 6 | 51·9±1·4 | 47·8±1·1 |
| 3/49/14 .. | 18·7±3·2 | 16 | 38·1±3·6 | 25·5±2·8 | 6 | 50·7±1·4 | 47·3±1·2 |
| Mean .. | 19·8 | | 40·6 | 24·8 | | 51·5 | 48·8 |
| | Diploid | | | | | | |
| 19/48/3 .. | 17·1±2·4 | 25 | 29·6±2·0 | 20·3±1·6 | | | |
| 27/48/3 .. | 15·9±2·3 | 21 | 28·3±1·3 | 19·9±1·4 | | | |
| Mean .. | 16·5 | | 29·0 | 20·1 | | 44·0±3·6 | 40·6±2·6 |

There is considerable variation between trees in their mean seed weights and although the tetraploids, on the whole, produced heavier seeds than diploids, the difference was not statistically significant. Nevertheless, from other records available, there can be little doubt that the tetraploid seeds tend to be heavier than diploid. Seed

weights of a large number of diploid trees have been recorded for other purposes and the means of these range from 11·2 to 19·6 mg. The upper limit of this range was exceeded by three out of the six tetraploids.

Tetraploids differed significantly ($P = <0·01$) from diploids in the length and width of the stomata on the first seedling leaf. Of the 113 tetraploids measured, only six had stomata whose length fell within the range of the diploids. The difference between diploids and tetraploids was not so great for stomata width and there was a greater overlap in the ranges. Tetraploid pollinia were significantly longer ($P = <0·01$) than diploid and there was very little overlap in the ranges.

It would seem, therefore, that stomata size, more especially stomata length, is a good criterion by which to recognize tetraploids at an early stage.

**Chromosome Numbers in Tetraploid Progeny.**

The original induced tetraploids were growing intermingled with a rather greater number of diploids, and as they both flowered over the same period, there was ample opportunity for intercrossing between the two. Of the 99 seedlings in which chromosome counts were made, 64 were tetraploids with 52 chromosomes; in 29, accurate counts could not be made, but they were approximately tetraploid; and the remaining 6 had 38, 39, 50, 51, 53, 54 chromosomes respectively. The fact that only one triploid and one aneuploid triploid were found, in spite of diploid trees being in the majority in the plantation, suggests that tetraploids are largely isolated as a breeding unit.

**Tetraploid Morphology, Bark Thickness, and Tannin Content.**

Tetraploid trees are fairly easily recognized in the field. The leaves are coarser than those of diploids, having longer, wider pinnules, but the overall length may be somewhat reduced, while shoots tend to have shorter internodes, giving the foliage a dense, "bunched" appearance. From the practical point of view, the most important differences are in vigour and crown form. When growing under plantation conditions, black wattle usually has well defined apical dominance leading to a single stem and a long, pointed crown. Apical dominance was not so well defined in the tetraploids and at a height of 10 to 15 feet, a high proportion of trees divided into multiple leaders, giving a wide, branched crown. In extreme cases, multiple stems were produced at or near the ground level and repeated branching produced a spreading, bushy or semi-bushy tree. Only a small proportion of the trees had a single stem and pointed crown and in these, the stem tapered more rapidly than is usual in diploids. There was a difference between families in the proportion of trees having the bushy or more normal type of growth. Evidently one effect of tetraploidy has been to unbalance the genes or gene complexes which control apical dominance. Of the triploids, only the aneuploid survived and this is a weakly tree which so far has not produced any flowers.

Because of the prevalence of bushy types in tetraploids, it is not possible to make a satisfactory overall comparison with diploids when height and diameter are taken as criteria of vigour. To obviate this difficulty and arrive at some comparison, only the best trees in a tetraploid stand were chosen for comparison with a representative sample of diploid trees of the same age growing under similar conditions, i.e. the best of the tetraploids were compared with the average of the diploids. Two such sets of comparisons were made.

In 1952, the progeny from 18 colchicine-treated trees, all thought to be tetraploid, were planted intermingled, but a number of the seedlings proved to be diploid, probably due to mixoploidy in the parent tree. Forty-two of the best tetraploids and 29 diploids were measured for height and diameter when $2\frac{1}{2}$ years old and in the following year, the same trees were measured for diameter and a bark sample was taken at a height of $4\frac{1}{2}$ feet for thickness measurements (Table V).

In 1954, a second group of tetraploid progeny from colchicine-treated trees was planted. This included a number of inbred families and families from the controlled pollination of a single tree with mixed pollen from several other tetraploids. In 1960,

when this group was six years old, 22 of the best trees were selected, measured for height and diameter, and a sample of bark taken at quarter-height for tannin analysis and bark thickness measurements, since quarter-height bark samples have now been found to be fairly representative of the bark of the whole tree. In an adjacent plantation of the same age, 23 comparable diploid trees were chosen and similar measurements made (Table V).

TABLE V

*Height, diameter, bark thickness, and tannin content of comparable diploids and tetraploids*

| | Number of trees | Age (years) | Height (feet) | Diameter (inches) | Bark thickness (mm.) | Tannin (%) |
|---|---|---|---|---|---|---|
| Diploid .. .. | 29 | 2·5 | 20·4±3·42 | — | — | — |
| Tetraploid .. | 42 | 2·5 | 18·3±2·26 | — | — | — |
| Diploid .. .. | 29 | 3·5 | — | 4·7±0·86 | 5·4±0·87 | — |
| Tetraploid .. | 42 | 3·5 | — | 3·8±0·47 | 5·5±0·89 | — |
| Diploid .. .. | 23 | 6·0 | 50·2±3·08 | 6·9±0·95 | 5·0±0·91 | 39·0±3·19 |
| Tetraploid .. | 22 | 6·0 | 34·6±2·29 | 5·7±0·78 | 6·0±0·98 | 41·2±3·33 |

The 1952 plantation was poorly grown owing to the prevalence of couch grass on the site, and the overall vigour of the trees was not as good as could be expected under average conditions. The diploids were significantly more vigorous than the tetraploids ($P=<0·01$), but in spite of much smaller diameter, the tetraploid bark was as thick as that of diploids. The 1954 trees were grown under more favourable conditions and the superiority of the diploids in height and diameter was very marked and statistically significant ($P=<0·01$). Tetraploid bark thickness and tannin content were both significantly greater ($P=<0·01$ and $P=<0·05$ respectively) than in diploids in spite of the overall poorer growth of the trees.

**Disease and Pest Susceptibility.**

There was no evidence that tetraploids differed from diploids in susceptibility to gummosis and black butt, the two main diseases of wattle. Tetraploids were, however, much more severely attacked by the wattle bagworm (*Kotochalia junodi*). A severe attack of bagworm occurred at the Experiment Station in 1957 and an estimate was made of the intensity of infestation on diploids and tetraploids in the 1952 plantation. Bagworm attack was recorded as light (a few bagworms, but no noticeable defoliation), moderate (sufficient bagworms to cause partial defoliation), and heavy (trees completely defoliated) (Table VI).

TABLE VI

*Degree of infestation of diploids and tetraploids by the wattle bagworm*

| Degree of infestation | Diploid | | Tetraploid | |
|---|---|---|---|---|
| | Number of trees | Percentage | Number of trees | Percentage |
| Light .. .. .. .. | 20 | 37·7 | 44 | 17·5 |
| Moderate .. .. .. | 21 | 39·6 | 115 | 45·6 |
| Heavy .. .. .. .. | 12 | 22·6 | 93 | 36·9 |
| Total .. .. .. .. | 53 | | 252 | |

Assuming that moderate and heavy infestations constitute a damaging attack, then 62·2 per cent. of the diploids and 82·5 per cent. of the tetraploids were damaged by bagworm.

The tetraploids planted in 1954 also suffered a severe bagworm attack in 1957. No estimate was made of the infestation in this group, but the great number of bagworms per tree and the high degree of defoliation compared with the surrounding diploids left no doubt that the tetraploids were more susceptible to damage by this insect.

**Discussion.**

In every example of valuable induced polyploids produced in crop plants, the initial product has had disadvantages which have only been removed by an extensive breeding programme (Stebbins 1956). It could not be expected, therefore, that induced polyploidy in wattles would produce an immediate overall advantage over diploids, but rather it was hoped that tetraploids would show sufficient superiority of some characteristics to warrant pursuing a breeding programme. In the tetraploids produced, both the commercially important qualities of tannin content and bark thickness are higher, on the average, than in diploids, but because of the slow growth and poor form, there can be no doubt that the yield of tannin per acre from tetraploids would be far below that of diploids. Unless the form and vigour of the tetraploids can be improved very considerably by selection, they have no future as a commercial proposition. Polyploidy in wattle has, however, been induced on only a small scale and there are differences in form and vigour between the progenies from individual tetraploid trees. In this respect, tetraploids are somewhat similar to what has been found on inbreeding wattles. Some inbred families have good form and strong apical dominance, while others have wide, branched crowns reminiscent of tetraploids. It seems possible, therefore, that the type of genetic unbalance produced by tetraploidy is similar to that produced by inbreeding. If this is so, the induction of tetraploidy on a wider scale might give polyploid lines superior to anything produced so far, more particularly if seed were taken from trees known to have high tannin content and strong apical dominance in their progeny. Unfortunately, breeding work on wattle is costly in time and land, and it is extremely doubtful whether it is a commercially worthwhile proposition to attempt to improve the vigour and poor morphological characteristics of tetraploids unless some more promising basic material can be found. On the other hand, it is perhaps too early to discard the whole proposition as useless. It is proposed, therefore, to continue the investigations on a limited scale only to determine whether better basic material can be obtained by treating seed from selected trees and whether the tetraploids will respond fairly readily to selection for form and vigour.

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# THE SIGNIFICANCE OF SUB-STANDARD BARK IN THE PRODUCTION OF WATTLE EXTRACT

By C. G. GORDON-GRAY and R. A. JONES

## Introduction

When it became necessary in the season 1958–59 to introduce a quota system to regulate supplies of wattle bark from growers, strong emphasis was placed upon the exclusion of immature bark. The regulations under which the quota system operates stipulate that

> "No bark shall be removed . . . unless it is derived from wattle trees the bark of which can be distinguished by a grey rather than a green colour."

This definition inevitably gives rise to difficulties in that there is no means of distinguishing between the thin, green bark from the tops of mature trees and the thin, green bark from immature trees. In practice, all such bark is either degraded or rejected outright. Of course, the exclusion of green bark from mature trees can be regarded as one, reasonably equitable, means of reducing supplies alternative to a proportionate further reduction of acreage. The exclusion of such bark and other 'reject' grades does, nevertheless, represent a considerable loss of raw material to the industry and it appeared desirable to re-examine and analyze existing data to find out more about the significance of this loss.

In the case of dry bark to be exported as such, there can be no doubt about the necessity for maintaining the highest possible standard not only of composition, but of appearance also. In the manufacture of wattle extract, however, different considerations apply, for here the chief desiderata are the tan content and the colour of the finished product. The present investigation examines the bearing upon these properties of green bark from mature trees and of bark from trees suffering from black-butt.

## The Effect of Green Bark.

The exclusion of green bark from mature trees means the rejection of the uppermost seven to fourteen feet, according to the height of the tree, and this usually represents about five per cent. of the total weight of bark. In the course of a long series of experiments on sampling methods (Anon. 1956), a very large number of bark samples taken at different heights in the tree had been analyzed by the method described below, and the availability of these results made possible an examination of the effect of such exclusion.

The bark from each of sixteen 8-year-old trees, taken at random from a four-fifth acre plot of 400 trees, was harvested in consecutive three-foot bands from the base to the apex of the main stem, stripping being continued to a height corresponding to a stem diameter of approximately one and a half inches.

Each band was removed as a collar and dried at 115°F. After standing at normal room temperature for a further week to allow the moisture content of the bark to reach equilibrium with the air, each band was weighed, chopped by hand, and the oven-dry weight of the bark calculated after determining the moisture content of the chopped bark by taking three random samples (±20 g. each). The analysis of the bark from each band was carried out in duplicate, the two sets of samples being analyzed on different days. Although the number of 3-foot sections in the sample trees varied with the height, only the top six and the bottom three sections have been taken into account in the summarized results in Table I.

TABLE I

*The mean dry bark weights and tan and non-tan percentages of consecutive three-foot bands of bark*

| | Bark weights in grams | Tan percentage | Non-tan percentage |
|---|---|---|---|
| Top of tree | | | |
| 1st 3 ft band .. .. | 209 ± 83 | 34·5 ± 3·67 | 16·5 ± 0·62 |
| 2nd 3 ft. band .. | 289 ± 75 | 35·5 ± 3·34 | 16·4 ± 0·88 |
| 3rd 3ft. band .. .. | 362 ± 113 | 35·6 ± 4·47 | 16·2 ± 0·93 |
| 4th 3 ft. band .. | 430 ± 134 | 36·2 ± 4·02 | 16·1 ± 1·14 |
| 5th 3 ft. band .. | 513 ± 178 | 36·5 ± 4·05 | 15·9 ± 1·26 |
| 6th 3 ft. band .. | 574 ± 142 | 36·8 ± 4·85 | 15·6 ± 1·37 |
| Next 3 ft. band .. | 997 ± 345 | 41·2 ± 4·01 | 14·2 ± 1·10 |
| Next 3 ft. band .. | 1,093 ± 392 | 42·2 ± 3·35 | 14·2 ± 1·30 |
| Bottom 3 ft. band .. | 1,580 ± 560 | 44·8 ± 3·87 | 13·7 ± 1·20 |
| Bottom of tree | | | |

Although the top nine feet of strippable bark in each of the sixteen trees was green in colour, there was no change in the tan and non-tan percentages which could be correlated with the change in the external colour of the bark from grey to green. In fact, in the top three or six feet of bark in some of the trees, an increase in tan percentage occurred against the normal gradient. This does not conform with the general belief that green bark from the tops of mature trees is necessarily inferior to comparable grey bark taken from the same height.

The results show clearly, however, that the tan/non-tan ratio of the bark at the tops of trees is lower than that at the base, and consequently suggest that the quality of extract would be improved by discarding the bark from the upper portions of the tree. The tan and non-tan percentages must, however, be considered in relation to the total bark weight of the whole tree. In the trees harvested, the basal nine feet of bark not only contains the highest percentage of extractives, but also accounts for approximately one-third of the total bark weight, whereas the top eighteen feet of strippable bark with relatively low extract value, accounts for only approximately one-fifth. When a weighted average is taken, the influence of the bark from the upper portion of the tree on the quality of the extract obtained from the rest of the bark is, therefore, relatively slight.

Sixteen trees taken at random have been found to be representative of such a plot as this (S.E. of mean of undried bark weights ±2·65), so that the weights and percentages of the various water-soluble components obtained from the total bark, and those from the bark after the top eighteen feet have been discarded, can be compared on an acre basis of 500 trees (Table II).

TABLE II

*Weight per acre and composition of bark stripped to different heights*

| | Oven-dry bark weight in lb. | Extractives | | Tans | | Non-tans | | Tan/non-tan ratio |
|---|---|---|---|---|---|---|---|---|
| | | Weight in lb. | % | Weight in lb. | % | Weight in lb. | % | |
| Total bark .. .. | 12,456 | 6,918 | 55·5 | 5,077 | 40·8 | 1,844 | 14·8 | 2·76 |
| Less top 3 ft. .. | 12,225 | 6,799 | 55·6 | 4,996 | 40·9 | 1,806 | 14·8 | 2·76 |
| Less top 6 ft. .. | 11,906 | 6,632 | 55·7 | 4,882 | 41·0 | 1,753 | 14·7 | 2·79 |
| Less top 9 ft. .. | 11,507 | 6,424 | 55·8 | 4,736 | 41·2 | 1,689 | 14·7 | 2·80 |
| Less top 12 ft. .. | 11,032 | 6,173 | 56·0 | 4,561 | 41·3 | 1,612 | 14·6 | 2·83 |
| Less top 15 ft. .. | 10,466 | 5,870 | 56·1 | 4,348 | 41·5 | 1,522 | 14·5 | 2·86 |
| Less top 18 ft. .. | 9,832 | 5,531 | 56·3 | 4,108 | 41·8 | 1,424 | 14·5 | 2·88 |

By discarding the upper eighteen feet of strippable bark, in this case 21 per cent. of the total, the extract would be improved by an increase of 1·0 per cent. in tans and a decrease of 0·3 per cent. in non-tans, equivalent to an increase of 0·12 in the tan/non-tan ratio.

It is well known that at the commencement of each season, the extract factories have some difficulty in producing extract of the required tan content because of the lower tan/non-tan ratio in the bark. It is doubtful whether, at that time of the year, the position would be radically altered by discarding the bark from the upper half of the trees, since the resulting difference in tan/non-tan ratio is well below the normal seasonal variation. Further, the indications from unpublished work are that the accumulation of non-tans during the unfavourable season takes place primarily towards the base of the tree.

There is thus no evidence of substantial advantage, in terms of quality of extract, to be gained by discarding any portion of the bark.

**The Effect of Black-Butt.**

In black-butt, one of the diseases which seriously affect the bark of black wattle trees, the cortical cells are killed, leaving a layer of hard, black material forming an outer cover to the bark. In this respect, it differs from the other major disease, gummosis, which appears to originate in the cambium and in the innermost phloem tissues. These cells break down, resulting in an accumulation of gum which eventually, by disrupting the cortical cells, bursts outwards. Bark affected by either of these diseases does not find a ready market because of the belief that it contains less water-soluble extractives and that it has a deleterious effect on the colour of the extract.

The present investigation was carried out to determine the effects of black-butt on (*a*) the weight per unit area and moisture content of undried bark and (*b*) the tan and non-tan percentages and the colour of the extract from the bark.

Throughout this work, diseased bark is defined as that in which at least a portion of the cortex of the bark has died, with the result that, in cross section, the outer portion of the bark is black, while the inner portion is white. No samples consisted of healthy bark carrying only superficial symptoms of black-butt, or of entirely diseased bark, which could not, in any case, be stripped from the trees. Since a large concentration of tannin in the bark is normally present between the pericycle and the cork cambium (Welch *et al.* 1924), it was thought advisable not to draw a distinction between degrees of infection, but to treat diseased bark as a single entity.

The tan percentage of the bark varies considerably in adjacent healthy trees even of the same diameter, differences larger than 10 per cent. having been recorded at this Institute. It was considered unlikely, therefore, that comparisons of total bark from trees (healthy and diseased) would reveal significant differences unless a large number of analyses were carried out. Operations on this scale were impracticable by the method normally in use, but it seemed likely that a small-sample method would be feasible and give adequate information.

It has been shown that although the tan percentage decreases markedly from the base of the tree to the top, only a relatively slight variation occurs around the circumference at any given height above the ground. Since this variation appears to be independent of the external features of the bark, small, paired samples, approximately four inches by two inches, were cut for analysis from each tree, one from healthy and one from diseased bark, at any height above the ground provided that healthy and diseased bark were present at that level. For bark weight and bark moisture determinations, two or three pairs of one and a quarter inch discs were taken from the same areas of bark, ensuring that comparative discs were always taken at the same height.

The samples for analysis were taken from two different wattle-growing areas, Eston and Noodsberg. At Eston, where fifteen different comparisons were carried out, the black-butt infection was confined to the base of trees, the rest of the bark being healthy, while at Noodsberg (twelve pairs of samples), usually the whole tree was black and some

difficulty was experienced in finding a healthy piece of bark below a height of seven feet. All the samples for tannin analysis were dried at a temperature of approximately 110°F. for two days.

The detrimental effects of the disease on the content of extractives and on the colour of the infusion were so obvious in the results as not to require statistical analysis. The average differences between the two types of bark are shown in Table III.

TABLE III

*Analytical differences between healthy and black-butt bark*

| Extractives % | Tans % | Non-tans % | Red units | Yellow units | Tan/non-tan ratio |
|---|---|---|---|---|---|
| *Eston—Mean of 15 pairs of samples.* | | | | | |
| —13·2 | —9·2 | —3·9 | +2·5 | +4·0 | +0·346 |
| *Noodsberg—Mean of 12 pairs of samples* | | | | | |
| —10·5 | —6·7 | —3·9 | +3·9 | +6·4 | +1·082 |
| | *Average values for diseased and healthy bark* | | | | |
| *Healthy* | | | | | |
| 61·0 | 47·4 | 13·6 | 4·4 | 5·9 | 3·485 |
| *Diseased* | | | | | |
| 49·0 | 39·3 | 9·7 | 7·5 | 10·9 | 4·052 |

From a comparison of twenty-five pairs of samples for moisture determination, it was found that while no difference due to disease occurred in the undried bark weight, the moisture of the infected bark (44·6 per cent.) was, on average, 4·5 per cent. lower than that of the healthy bark (49·1 per cent.). On the other hand, the moisture content of the air-dry diseased bark was significantly higher than that of healthy bark (P=0·01).

The results show that black-butt disease appears to have no effect on the overall weight of the undried bark, but causes (*a*) a decrease in moisture content of the bark at the time of harvesting, (*b*) a drop in the percentage of tans and non-tans when these are calculated on an oven-dry basis, (*c*) an increase in both red and yellow colour units, and (*d*) a higher moisture content in the air-dry state.

From the data obtained, it is possible to compute (Table IV) the changes in extractives and tan content of bark and in colour of extracts that could be expected to arise from admixture of varying proportions of diseased (black-butt) bark in consignments of undried bark.

TABLE IV

*Effect of different proportions of black-butt bark on bark composition and extract colour*

| % Diseased bark in a consignment | % Decrease in extractives | % Decrease in tans | Increase in red colour units* |
|---|---|---|---|
| 10 | 0·39 | 0·23 | 0·31 |
| 20 | 0·78 | 0·46 | 0·62 |
| 30 | 1·17 | 0·69 | 0·93 |
| 40 | 1·56 | 0·92 | 1·24 |
| 50 | 1·95 | 1·15 | 1·55 |

*These differences are based on air-dry bark; it is possible that they would be less in extracts obtained from undried bark.

## ACKNOWLEDGEMENT

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# NOTES ON WATTLE INSECTS OBSERVED DURING THE PERIOD 1959 - 1960

By (the late) L. L. J. OSSOWSKI and G. B. WORTMANN

An account is given of the insects observed damaging wattle plantations in Southern Africa during 1959-1960 and of the areas affected. Several insects not previously recorded as potential wattle pests are listed.

The population of some insects increased during the year under review, notably that of the wattle bagworm and of some chafers. In areas with a high rainfall, a decrease was noted in the population of anthocorids, jassids, and capsids. Two beetles, *Hoplia sordida* Burm. and *Gonocephalum chatanayi* Geb., and two weevils, *Polyclaeis equestris* Boh. and *Sciobius mordax* Mshl. were recorded for the first time as attacking wattle.

## I. ORDER: LEPIDOPTERA

### Family: *Psychidae*

1. *Wattle Bagworm,* Kotochalia junodi (*Heyl.*).

The area infested with bagworms during the 1959–60 season amounted to 250,000 acres. The infestation in the Transkei has entered the first year of the prodromal stage and during 1960–61, the eruption, with consequent defoliation, may be expected over more than 4,000 acres. In the southern area, the crisis has been reached in some plantations around Paddock; some areas will, however, still suffer partial defoliation. In the Ihluku-Harding district, the infestation is still in the eruptive stage and defoliation is to be expected during the coming season over some 10,000 or more acres. In plantations west of Ixopo, the crisis and abatement may take place during 1960–61, while in the remainder of that area, infestation may still remain in the eruptive stage during the coming season and large areas will be defoliated. In the Richmond district, nearly 16,000 acres were defoliated during the past season and up to 20,000 acres may suffer defoliation during 1960–61. Infestation around Eston is heavy, but an abatement will take place during 1960–61; several thousand acres will, however, still be infested and defoliated.

In the Lion's River, Howick, and Karkloof area, over 4,000 acres were infested and partially defoliated during the past season. The infestation is building up in some of the easterly plantations of the Karkloof, from where the infestation will spread towards Albert Falls.

The Midlands, especially plantations in the New Hanover, Umvoti, Greytown, and Kranskop Magisterial Districts, are very heavily infested and defoliation over 50,000 to 60,000 acres is to be expected during 1960–61. In Zululand, where nearly 20,000 acres were infested during the season under review, the infestation has entered the second year of the prodromal stage; the cycle is still on the up-grade, but in some parts, especially north of Melmoth, the crisis, followed by the abatement, may take place in 1960–61. Defoliation of 15,000 acres or more may still be expected.

In the Glückstadt-Enyati plantations, where 15,000 acres were completely defoliated during 1959–60, the crisis and abatement will take place in 1960–61 in some

plantations north of Glückstadt. The infestation around Scheepersnek and in the southern part of the Kambula area is rapidly building up and in some plantations has already entered the first year of the prodromal stage. Over 3,000 acres will be defoliated during 1960–61.

In the Paulpietersburg area, some 15,000 acres were partially or completely defoliated during 1959–60. The infestation is still on the up-grade and up to 20,000 acres will be defoliated during 1960–61. In the Transvaal, the infestation is very heavy. Plantations around Amsterdam, between Piet Retief and Kemp-Iswepe, and between Piet Retief and the Swaziland border were heavily infested and nearly 20,000 acres were defoliated. The infestation is still on the up-grade, and defoliation of a similar area is to be expected during 1960–61. In Swaziland, the crisis was reached south of Goedgegun in 1959–60. In wattles between Goedgegun and Hlatikulu, the crisis and abatement may take place during 1960–61, but partial defoliation of 500–900 acres is still to be expected.

2. *Lictor Bagworm,* Clania moddermanni (*Heyl.*).

The population of this psychid increased considerably in the Inyanga district of Southern Rhodesia. Approximately 200 acres of 3 to 8-year-old plantations were affected. Damage to shoots and leaves was, however, negligible.

**Family:** *Lasiocampidae*

3. *Small Wattle Lappet Moth,* Anadiasa punctifascia *Wlk.*

Some 2,000 acres of wattle plantations were infested mainly in the Paddock, Harding, and Richmond areas and of this, nearly 800 acres were partially or completely defoliated. In the Richmond district, a white fungus, *Beauveria bassiana* (Bals.) Vuill., commonly known as "muscardine", was responsible for reducing the larval population of this insect.

4. *Grey Wattle Lappet Moth,* Pachypasa truncata *Wlk.*

Outbreaks of this pest were observed around Ermelo, Piet Retief, and Moolman in the Transvaal, and Paulpietersburg and Vryheid in Natal. A total of 500 acres was reported to be defoliated by these lasiocampids.

**Family:** *Saturniidae*

5. *Wattle Emperor Moth,* Gynanisa maia (*Klug*).

This moth was fairly abundant in plantations around Eston; damage was, however, negligible.

6. *Pine Tree Emperor Moth,* Nudaurelia cytherea capensis *Stoll.*

Around Worcester in the Cape Province, crowns of 7 to 15-year-old wattles were reported to have been defoliated by this emperor moth. Larvae of *Nudaurelia* (probably *N. cytherea cytherea*) were also found in wattle plantations around Ermelo in the Transvaal. No damage was observed.

**Family:** *Noctuidae* (*Agrotidae*)

7. *An* Agrotis *sp.*

Larvae decimated wattle seedlings in small areas of plantations around Inyanga in Southern Rhodesia.

**Family:** *Limacodidae*

8. *The Cup and Saucer Moth,* Coenobasis amoena *Feld.*

This species was observed in many plantations. Its population has, however, been kept on a low level by parasites, viz. *Systropus crudelis* Westwood (*Bombyliidae*), a *Chrysis* (*Pentachrysis*) sp. (*Chrysididae*), and a *Eurytoma* sp. (*Eurytomidae*).

## II. ORDER: COLEOPTERA

### Family: *Melolonthidae (Scarabaeidae)*

9. *Large Wattle Chafer,* Hypopholis sommeri *Burm.*

During 1959–60, this beetle damaged some 5,000 acres of wattle of all ages, mainly in the southern part of the wattle growing area. The heaviest infestations were noticed in Pondoland and around Harding and Ixopo. Some plantations were completely defoliated and stripping had to be stopped.

10. Hypopholis vittata *Fhs.*

This beetle occurred in large numbers together with *H. sommeri* (9) especially around Ixopo.

11. *Small Wattle Chafer,* Monochelus calcaratus *Burm.*

Nearly 700 acres were defoliated by this beetle, mainly around Ixopo, Lion's River, and Greytown.

12. Hoplia sordida *Burm.*

This species was found feeding in large numbers on young wattles around Eston. Damage was, however, negligible.

13. *Mashonaland Chafer,* Eulepida mashona *Arrow.*

This chafer is present in many plantations around Chipinga and Melsetter in Southern Rhodesia. Where numbers of larvae are large, local control is maintained by application of soil insecticides.

### Family: *Tenebrionidae*

14. Gonocephalum chatanayi *Geb.*

Adults of this species damaged extensively approximately 15 acres of a newly established wattle plantation in the Kambula district. A large proportion of the damaged area had to be re-established.

### Family: *Eumolpidae*

15. Colasposoma flavipes *Hav.*

Adult beetles partially defoliated some 30 acres of young wattles in the Paddock area.

### Family: *Curculionidae*

16. Polyclaeis equestris *Boh.*

This weevil was abundant in young plantations between Piet Retief and the Swaziland border. Damage was, however, negligible.

17. Sciobius mordax *Mshl.*

Damage to small wattles was seen in the Paddock area.

## III. ORDER: HEMIPTERA

The following sucking insects are commonly known under the misleading collective name of "froghopper":

### Family: *Anthocoridae*

18. *A* Cardiastethus *sp.*

**Family:** *Capsidae* (*Miridae*)

19. *A* Lygus *sp.*

20. Ortholytus tabidus (*Stål.*).

21. Lygidolon laevigatum *Reut.*

**Family:** *Jassidae* (*Cicadellidae*)

22. Bythoscopus cedaranus *Naudé.*

23. *A* Distantia *sp.*

There was less evidence of this group of insect pests in areas with higher rainfall, but in drier parts of the wattle belt, damage was severe, especially around Vryheid, the lower-lying parts of the New Hanover area, and in the Paddock district, where a total of 5,000 acres was infested and approximately 2,000 acres damaged.

Extensive damage by "froghopper" was also reported from the Vumba area near Umtali in Southern Rhodesia.

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